THE SCHOOL REVIEW

A JOURNAL OF SECONDARY EDUCATION

VOLUME XIV
NUMBER 4

APRIL, 1906

WHOLE
NUMBER 134

SCIENCE IN THE HIGH SCHOOL

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The science in the high school that flourished a generation or two ago is best known to us as "natural history." It is as far away from the science that flourishes in our universities and colleges or even our high schools, as the *Gentleman's Magazine* is from a *wissenschaftliches Centralblatt.*

It is not difficult to regret this passage, to recognize the human interest, the power of inspiring healthful curiosity, the fact that it was on all fours with even adolescent intelligence; to recognize, in a word, that it possessed reality for the student, and quickened rather than deadened his interest in the sciences to which it served as a humble portico. Our regret may even pass over into a program, an extension of the culture-epoch program. We can point out that it was out of beginnings such as these that the most scientific of modern sciences arose; that, further, the concrete interest, the shrewd guesses, the search for tangible causes, which a Franklin incarnates, is just the attitude which high-school boys and girls can take toward the physical world around them. And the conclusion to be drawn seems to be that secondary-school science should return to natural history as the proper introduction of the secondary-school child to science properly so called.

It does not seem necessary that the natural history of a modern school curriculum should embody the mistakes and crudities of an

earlier phase of the science. What is necessary rather is that the immediacy, the tangibility, the comprehensibility of the older natural history should replace the technical introduction to university sciences which have ousted it from its former place. That is, there is seemingly no necessity for the loss of immediate touch with the experience of the child.

Certainly the same problems face him which faced his father and grandfather, and there is unquestionably in him as in them the same native interest in the solution of these problems. Perhaps we should add: There is the same interest, provided they remain as concrete and comprehensible as those which his predecessors found or accepted when presented.

It is equally necessary to recognize, however, that while the same problems arise from one generation to another, the solutions differ with each scientific generation; and the fallacy of a culture-epoch theory lies in the assumption that, because the problems seem to be identical, it is possible to give the modern child the antiquated solution. We state only half of the educational problem when we emphasize this identity of attitude of the boy in his teens with that of the old-fashioned natural history. In spite of ourselves, we are compelled to answer his questions in the language—the scientific language—of today. And it is upon this difficulty that as yet our high-school science has been wrecked.

We cannot speak of fluids and forces and substances in what to us is the nonchalant manner of earlier days. The phenomena of the world about us have been translated into facts of motion, and the very things themselves—their substances and attributes—are defined in terms of motions. The teacher who has been adequately trained in his subject-matter cannot project himself into outworn theories, simply because they are more comprehensible to his students.

It is then only natural that he should assume that his task is to train the student to understand the language which he must eventually use in the solution of the problems he meets. He must understand and speak this language, if he is to solve the problems, so that it becomes of the first importance to master the vernacular. The problems—the familiar experiences of light, of heat, of electricity, of

chemical change, of growth and reproduction in plant and animal—can be safely postponed till he understands how so to state them that he may then satisfactorily answer them.

There have been, of course, many compromises offered, lying between the two positions suggested above: that science in the high school should be adapted primarily to the immediate interest of of the child, being taught only in so far as it is stated in terms which he understands, and only those problems being presented which arise naturally in his own consciousness; and that science can be profitably presented only in so far as it is expressed and received in the language which sciences uses; that it is a body of truth that cannot be diluted nor flavored to suit the taste of the child; that, on the contrary, it is the child's first duty to acquire that language, and put himself by this and similar training in a position to comprehend the actual problems of science, when presented to his more matured intelligence.

It cannot be said, however, that these compromises have succeeded. And it is natural that, on the whole, the scientific expert should carry the day. He stands for the university requirement in the first place; and, though but relatively few of the high-school students enter colleges or universities, the college requirement is, after all, a standard that is explicit and definite; while the world into which the majority of the students pass from the high school sets no explicit standards, and takes in general very little interest in the high-school curriculum.

The result is that at the present time science means from one to three possible units. University prescription lays the emphasis upon physics. Chemistry is but slightly encouraged, for college instructors in chemistry prefer commencing *de novo* to building upon foundations that can be laid in the high school. Biology may be represented by a general course which is an introduction to botany and zoölogy, or by a half or entire unit given to either. Here the modern physiological method is superseding the older systematic method, and there is present the somewhat unsatisfactory leaven of evolutionary ideas, which are either too dogmatic or too vague to serve the purpose for which they are used. The absence of mathematics favors biological science in the mind of the high-school

student, but its position is too isolated, and the demand for it in entrance requirements not general nor peremptory enough, to give it the importance which physics has obtained. Physiography, the lineal descendant of the older physical geography, is acquiring a growing importance, for reasons which will be discussed later; but it uses ideas which require training in physics and chemistry for comprehension, and, as generally taught, lacks the concreteness of experimental sciences.

The university influence upon the study of science has not been fortunate. Even its power to introduce definite standards has been attended with grave misfortunes. Entrance requirements present alternatives. The high school is encouraged to expend the money and hours at its disposal for science upon some one branch, and the result is that, even if a number of branches are represented, they are treated as units with little or no relationship to each other. And, as above noted, the university is the only power that comes forward with definite demands that have penalties attached to them. Thus the sciences in the high school are hopelessly isolated. They exist in water-tight compartments, with none of the interrelationships which are implied in their own subject-matter, and which are essential to their comprehension, especially for the student of this period. The textbook writer or the teacher trained in his subject unwittingly uses ideas belonging to a world of science, which his own specialty implies, and forgets that his students have yet to build up that world in their own experience.

That isolation is most felt in the separation between mathematics and those sciences of which it is the language. The students pursue algebra, geometry, and, reaching physics, where they meet the abstract quantity to the measurement of which these branches of mathematics are fitting them or should fit them, they do not and perhaps cannot feel the connection. The subject has been presented to them as a study quite by itself, much as grammar in the study of a language with which one is not familiar. As we have discovered that it is impossible for a child to learn the rules for the use of a language first, and then apply them in speech afterward, so we have to learn that the rules for mathematical processes cannot be acquired in advance of the application of these processes. It is

at least a fact which no one familiar with the teaching of physics will deny that the training, which children receive in algebra and geometry, as it is now taught, does not assist them in stating in mathematical terms the problems which physics presents. If there is any preparation which the teacher of physics would ask for, if he could get it, it would be that his students should come to him with the power of stating a physical problem in exact quantitative terms. But the formal training in adding, subtracting, multiplying, dividing, of whole numbers and fractions in algebra, does not advance a whit toward this end. The problems of physics call for the statement of continuous processes in discontinuous terms, of movements in number. The mathematical discipline that accomplishes this is algebra applied to geometry. But in high-school mathematics there is no suggestion that these two branches have any relationship with each other. And no training that the child receives in them there assists him in bringing the two together. They are completely isolated from each other and from physics.

This is so apparent that the demand on the part of the educational authority is for physics which shall not be predominantly mathematical, that there shall be a return to the standpoint of the old natural history.

This is, however, but a single illustration of a situation which embraces the whole field of science in the high school. That the child may really comprehend any of the phenomena which he studies in any field of science, it must be stated in terms of a world in which he lives and moves and has his being. That world is the naïve world of the child, and he cannot live in it and learn something that belongs to another world, the world of science. His whole world must be in some sense transformed before he can approach the problems of the separate sciences in a scientific fashion. The result of the type of teaching which is now predominant in our secondary schools is that, what the child learns does not interpret his own world at all. A teacher of psychology has recently complained that his classes have not the faintest knowledge of the physical phenomena of sound and light, though in the high school a very large proportion of them have studied these very topics. What they learned there did not enter into their own experience and become

an interpretation of the sounds that they heard, of the light that they saw.

The conclusion of this seems to be, not that we should turn to an antiquated method of presenting science, but that the child should be carried into the world of science before he is dispatched into the separate divisions of that world. And the high-school student should be brought into this world, not simply that he may overcome the isolation of the separate sciences in his curriculum, but because he has reached a period at which he naturally analyzes and refers the results of his analysis to some whole to which they belong.

The child below the high-school period has, as a rule, no such interest. Each experience is to him a matter of interest in itself, and though it is unconsciously interpreted by what he sees and hears and reads, still his interest does not lead him to make it consciously a part of some larger whole. All that he has learned or experienced converges upon the immediate thing before him. It does not radiate out into a new world which his thought constructs.

The predominant intellectual characteristic of the adolescent age is that the child wakes up to the existence of a world about him that he belongs to, but of which he is as yet ignorant.

Adequate materials for the reconstruction of his social world are placed at his disposal. Literature, history, stories of adventure and travel, especially novels of all descriptions, are in these days within easy reach, and are made so tempting in style, illustration, and content that the process of building up the new social world is pushed too fast, and the child becomes socially over-stimulated.

Something of the same opportunity is offered in popular works on scientific subjects. Boys' books of inventions and discovery, Jules Verne's stories, and the articles in our countless magazines popularizing scientific discoveries and methods, awaken an interest which the applications of steam and electricity keep alive. With these interests come the instincts for constructions and collections of various sorts, out of which a scientific spirit and a wide acquaintance with the world of science should result.

The result, however, is not what it should be. The study of science in the school is neither extensive enough, nor does it grow

out of the instincts and interests of the children. While the language of his new social world is that of everyday life, that of the science he studies is a mathematical vernacular, which is not even comprehended without serious effort, and, as we have indicated above, he is not even allowed to use the language till he has mastered its grammar and syntax. There is nothing into which he cannot enter by the door of his vivid imagination, if it is presented to him in terms of human experience. He acquires almost unconsciously the political and social structure of this world. It is essentially comprehensible to him from the start; while most scientific concepts and laws are acquired with painful effort. And this effort is requisite, not because the concepts and laws are incomprehensible in themselves, but because they belong to a different world from that of the child's immediate experience, and one that does not grow up naturally and unconsciously out of that experience.

It is this background of a scientific world which the high school must supply if it is to give the child the same natural attitude toward the scientific studies in the curriculum, as that which he occupies toward the studies in language, literature, and history. It cannot be given him as the *fait accompli* of the trained mind. It must grow out of the immediate experience of the child, and yet it must stand out as a whole within which lie the fields of the different sciences. It is impossible that the child should comprehend the meaning of a physical, as distinct from a chemical or a biological, problem, unless he has felt them arise out of a common matrix of experience.

Such a common matrix is suggested in physiography, not as it is presented in the textbooks of the subject, but as it might be presented in a course which would be an introduction to science. Physiography at least takes its world as a whole, and the world is in the main that which appeals to the direct sense-perceptions of the children. It presents that as a subject for investigation, and for the time being all the scientific problems are there lying side by side, and mutually conditioning each other. Problems of pressure and precipitation, of electricity, of solution, of plant and animal growth and distribution, of commerce and land formation, all arise from the study of the habitat within which the human race is found.

That habitat has a meaning as a whole for the child, and the problems that grow out of it are not isolated. On the contrary, they can be kept in intimate interrelation with each other and with the world within which they appear.

Physiography as presented in our textbooks assumes rather than develops the scientific conceptions. The students receive without any concrete experience terms such as "solutions," "precipitations," "warmth," electricity," "disintegration of rocks through weathering." The opportunity of making the important conceptions of science fundamentally real at the very outset is lost. They become terms with little meaning, that are oppressive rather than enlightening thereafter. The beginnings of scientific work with children must be field and laboratory work. Such a course in the introduction to science would be given best of all without a textbook. Taking as its starting-point the problems of erosion and weathering that are to be found on the large and small scale everywhere, coupling with this some of the problems of plant distribution and dependence upon surrounding conditions, field-work would be the beginning, while the questions of the effects of cold and heat, of solution and precipitation, the physical processes involved in wind and the change of the seasons, would present opportunities for laboratory experiment; in other words, for the development in the children's concrete experience of the conceptions necessary for the study of the physical environment as a whole. At the same time, it would be the differentiation of physical, chemical, and biological problems as distinguished from each other.

The problem of the proper relation of mathematics to the sciences is a much more serious one, and one that will involve a very considerable reorganization of the study of mathematics from the beginning. For the purposes of application to science, mathematics must be considered as the theory of the measurement of motion. Geometry and algebra—the continuous and the discrete—can never be separated from each other if this point of view is to be maintained. It is a point of view which should be maintained from the start—not one that has to be achieved with pain and effort later. The equation presented in the form of the graph is the natural tool, more easily grasped when properly presented than the

complicated manipulations of algebraic symbols in the processes of addition, subtraction, multiplication, division, with their applications in fractions and factoring. If mathematics were approached from this standpoint from the beginning, its value as the language in which scientific meaning is to be expressed would be won; instead of being a subject-matter largely incomprehensible because hopelessly abstract, it would become a transparent medium within which the concrete contents of science would appear.

There are, then, two great separations that have to be overcome in bringing science in the high school to its legitimate position, to its rights: (1) the separation between the science and the world to which it belongs—the isolation of the science—an isolation from the experience of the child, the isolation from the other sciences which leaves them each abstract and helpless within its own compartment; (2) the separation of the sciences from the language in which to so large a degree they must be expressed—a separation which is rendered necessary by the manner in which the mathematics is taught. It is this separation which constitutes especially the middle wall of division between the child and his expert instructor; it is this separation which calls for a physical science which shall be non-mathematical. The instructor has learned that his physical problem can be stated only in terms of mathematics, and is helpless when he is deprived of the medium in which alone he is able to express himself. There is no question that the highly abstract form in which the mathematical statements of university physics are given is unnatural to the boy and girl of the high school; but this is quite a different thing from the statement that their physical science should be presented without mathematics. It is not necessary that mathematical statement should be eschewed because the child is not interested in the niceties of exact mathematical statement. The graph remains a mode of presenting continuous change which is graphic and concrete, and which welds together what must be presented together if physics is to have the value of scientific training-motion measured in discrete terms.

There is another respect in which the influence of the university upon the high-school science has been unfortunate. In its sense of competency and the incompetency of the high school and the

high-school child to deal with science, the influence of the university has inevitably been to restrict the extent of the field of science in the high school. Let science be confined to that which the child in these years can accomplish in accordance with exact methods. It does not matter so much how much the child learns. The important thing is that he should make use of the proper method. The amount that he can adequately conceive is very small; let him therefore confine himself to that and do it correctly, leaving the rest to a period which is equal to the more difficult task. Thus he will at least bring to later study an unspoiled mind, and what method has been acquired will not have to be unlearned. From this standpoint it makes very little difference what a child learns, if he only does it in a really scientific manner. Let him keep the tentacles of observation sensitive. Whether his few observations are made in one subject or another is unimportant. The important thing is that he has learned to observe, to distinguish between what is uncritical assumption and what is fact. Science in the high school can almost be left to the chance of the equipment of the teaching force. If the science teacher is especially well equipped in biology, let the subject-matter be botany or zoölogy; if he is a physicist or a chemist, let one of these be the scientific pabulum of the child. What must be insisted upon is that the instructor be competent to direct the child's work in the scientific spirit and method, giving him the doctrine pure and undefiled.

I have already indicated that this is theoretically almost impossible, because the fundamental conceptions of all the sciences are so interwoven that it is impossible to pursue one branch by itself, without making use of conceptions which are to the child abstract and meaningless. If the position taken above is correct, it is necessary that these fundamental scientific conceptions be developed out of the experience of the child in a course which shall be introductory to all the sciences. But this isolated manner of giving a child his science does him a wrong that is more serious than that of forcing him to use conceptions that he does not comprehend. It deprives him of the world of science, to which he has as incontestable a right in his years as the adult in the university or elsewhere.

It has been already indicated that the child finds a literature so adapted to his intelligence that he is capable of fashioning in the adolescent period a social world into which all his experiences and acquirements fit naturally. It is not the world which he will have in his maturer years, when he has learned to apply historical criticism and literary judgment to the subject-matter of his study, but it is a world which is a whole, and which as a whole serves to interpret the individual things that he learns and experiences. Ancient history dovetails with the ancient languages and literature. Whether he is studying one or the other, it remains all a part of one organized piece of human experience. Each element serves to interpret the other. In the same way there arises very soon a mediæval period, even if it is gained only through the sources of Walter Scott. The Reformation, and the wars and struggles that gathered around it in England and the Netherlands and America, constitute another whole into which the different facts of history, modern institutions, and movements of population and commerce fit naturally enough, and from which they get their interpretation. There is no necessity of any fact or change standing shivering by itself. They can all have their relations brought out through the whole movement or situation to which they belong.

We should at once cry out that the child was being cheated if our high schools should deprive him of this whole, and the interpretation which it carries with it; if we should attempt to isolate history from language and literature, to isolate the study of institutions from that of biography, discovery, and warfare; if we should say the child cannot take the attitude of the historical critic as yet, but what he must learn at present is to use properly the method on a small scale, with a few facts. Let him then take some isolated problem in history and gather the data from sources; when he is older he will be able to comprehend what he has done. Let him simply keep his capacity for observation keen, and later he will come with a matured mind to grasp the import of what he observes. We should reply that, no matter if he does revise his judgments of men and affairs, their history and achievements, when he is older, he has an unquestioned right to comprehend and think them earlier according to his powers. He has a right to the world as he can

present it to himself, and especially to the interest and meaning which this carries with it. He has an equal right to the world of science as a whole for the meaning and interpretation which it carries with it; and a high-school curriculum which gives him some of the fragments of this world only, and does not allow him to form such an idea of it as an entirety, is cheating him out of what belongs to him at that time.

It is a commonplace of the times that we are living under the sign of science, that greater changes have been brought about by the applications of science to human affairs and apparatus than have ever been wrought before in human history. We recognize also that the discoveries of science have made the reconstruction of institutions, governmental and religious, necessary; that the bringing together of the ends of the earth, by steam and electricity, has presented us with entirely different moral problems, has reconstructed the theory of who is my neighbor. We know that change in scientific hypothesis has brought with it a new era even in philosophy. And yet, while the high-school student gets the sweep of the development of democracy as a whole, of the long struggle for liberty, of growth of empires and the spread of commerce; and while these vast organic wholes rest in the back of his mind to correlate the events of yesterday and today, he is not helped to a view of the scientific world as a whole. What he gets in this way is confined largely to the popular articles in the magazines, and the science he has in the school is so isolated that it does not even dovetail into this. It follows that, at a period when he is peculiarly sensitive to moral forces and ideas, he does not come into touch with the high morality of science, with its decalogue of disinterested exactness, its idealistic hypotheses, its gospel of human intelligence. Furthermore, the set he gets against science in the high school follows him into the university or out into the world. The scientists in the university complain that scientific courses are not placed upon the same level with the language and literature courses. They fail, however, to recognize that back of these latter courses lies a whole organized world of human experience that takes up into itself history, philology, literature; while back of their scientific studies lies at first almost nothing. The beginning

is a difficult reconstruction of current conceptions, or an equally difficult discovery of meaning in terms and phrases which have been loosely and uncomprehendingly used before.

This preliminary work should be done in the secondary school, not simply for the sake of the university, but for the sake of the student himself. For it is science that carries with it the most modern and the most profound culture, for the simple reason that it is science which is the source of our ideas and ideals, at least of the formative ideas and ideals.

DISCUSSION

Believing that the points raised by Professor Mead's paper would form a fruitful basis for discussion, the editors submitted the paper to three members of the scientific departments in the University of Chicago, whose comments follow. The editors would welcome further brief discussion of the paper by teachers of science in secondary schools or elsewhere. Any experiments already made along this line ought to be especially useful.—EDITORS OF SCHOOL REVIEW.

PROFESSOR FOREST RAY MOULTON, of the Department of Astronomy: Two things in Professor Mead's article particularly impress me. One is its indictment of present methods and results, which is undoubtedly supported by abundance of evidence; the other is its conception of the place of science in secondary education.

If we admit that science has, so far at least, partially failed, we have before us the problems of finding the causes of the failure, and then the remedy for it. While these questions doubtlessly have been carefully considered, too often it has been from the necessarily prejudiced point of view of the scientific specialist. The pressure of the marvelous development of research in this country during the last fifteen years has made specialists more and more narrow. The whole emphasis has been thrown on research in a narrow and technical sense; and the method, rather than the spirit, of this epoch has spread beyond its legitimate bounds, and has forced itself into domains where it cannot find a place. As has been so well pointed out in the article, a student's conception of anything depends not only upon the thing, but also to a very great extent upon his own intellectual horizon and body of experience. It is when we forget this, that we expect a more or less technical scientific fact or theory to become as fully a part of the intellectual life of a young student as it is of our own. I feel that many serious mistakes have been made by not recognizing the narrow horizon of the student and his lack of interest in wide generalizations until adolescence, and it seems to me that the suggestion of turning again more toward natural history is in the nature of a remedy. Yet the difficulty is largely one of method and general attitude, and must be overcome whenever it appears.

The ideas encountered respecting the object and usefulness of scientific study are extremely varied. Parents and students usually regard science as having only a narrow utilitarian value. The educated classes recognize that it has enormously extended our experience by making the whole civilized world in effect a single community. Some of the more reflective minds recognize that it has had a deep and really revolutionary influence on the fundamental conceptions of philosophy, morality, and religion, and that its spirit and method have to some extent permeated every phase of intellectual activity. Probably its greatest contribution so far to secondary education has been indirectly through the influence of its spirit upon the humanistic and linguistic subjects. But, in my opinion, its high mission, which so far has not been realized, is not to work marvelous changes in our physical lives, or to enable us to see the activities of the whole world, or to compel us to modify old systems and creeds, or to make more valuable the study of other subjects; it is, rather, to flood our minds with the riches of the universe which surrounds us, to show us the perfect system and order and unity of nature, to dissipate the almost universal superstition by instilling in us a firm belief in what we call cause and effect, to make us honest and fearless with ourselves, and to give us breadth and balance and sanity and highly cultivated common-sense. If the high-schools can in some way make real science a part of the lives of all the the students who go out from their halls, may we not look for as great a change in the intellectual lives of the next two generations as the physical lives of the last two generations have undergone?

As one whose interests to some extent reach beyond his own specialty, let me express my appreciation of the paper and its attitude.

PROFESSOR ROBERT ANDREWS MILLIKAN, of the Department of Physics: I shall confine my discussion of Professor Mead's paper mainly to its bearing upon the teaching of physics, because this is the only division of science concerning which my experience enables me to speak with any authority or knowledge.

I find myself in the fullest agreement with the author in the attitude which he takes toward the influence which, in the main, the university has had upon the course in physics in the secondary schools. This influence has been unfortunate, (1) because it has tended to force university methods and university material into a sphere of education to which they are wholly unsuited, and (2) because it has tended to restrict high-school physics to too narrow a field, making it, to too large an extent, a minute study of the mathematical and mechanical foundations upon which technical science is built, rather than an inspiring insight into the meaning of the physical world.

This result has been brought about, I think, not so much because of a conscious effort on the part of university teachers to make high-school science merely a technical introduction to university science, as because of (1) ignorance on the part of many of the makers of college-entrance examinations and college-

entrance requirements of the conditions and needs of high-school work, and unfamiliarity with any sort of physics save that which they teach in their own classrooms; and (2) incompetence on the part of hundreds of high school teachers, which is responsible for the fact that their high-school courses are mere duplicates of the courses which they themselves were taught in college.

It is my observation that this state of affairs is passing away in the better grade of high schools. The tyranny of the university over the high-school is surely coming to an end. The field of the high-school physics course is rapidly broadening, and the technical introduction is being rapidly replaced by an immediate presentation, in language which the student already understands, of the *hows and whys* of familiar physical phenomena, followed, not preceded, by a limited introduction to the technical language of physics in the translation of ideas already gained into equations and graphs. As a result of this change, I can now name a number of schools in which physics is the most popular subject in the curriculum.

As to the second point raised in Professor Mead's paper, namely the relations of the sciences to one another, I give enthusiastic welcome to an experiment upon such a general introductory science course as he suggests. The attempt to impress the student at the beginning of his course with the oneness of the world of science, and to give him some familiarity with the sort of problems which are dealt with in the various divisions of this world, as well as some little knowledge of the terms and symbols which are met with in each division, should assist greatly in the presentation of all the sciences. Furthermore, the immediate feasibility of the proposed plan is one of its attractive features. It will be a comparatively easy matter to transform the present physiography course into a course of the type proposed.

The third problem which Professor Mead discusses, namely, the correlation of science and mathematics, is one the solution of which is much more difficult, and the source of the difficulty is found simply in the fact that *elementary science demands for its adequate presentation an extremely small amount of mathematical training*. One single theorem in geometry, namely that of similar triangles, will suffice for a complete course in physics, and not more than five or six theorems at the most ever find application. With algebra the case is not very different, for the equations which need to be handled in science-teaching are of the simplest nature. The mathematical problem of the physics teacher is simply to teach the student to express in mathematical form physical relations which he already understands, but the *manipulation* of the equations which are met with in elementary physics is extremely simple; so that, if we regard mathematics *only* as the language of science, and postpone the development of every mathematical proposition until we actually need this proposition in our work in physics, we shall eliminate from 75 to 90 per cent. of the mathematics which the high-school course now contains. There are perhaps those who would be willing to see some of it eliminated, but such a wholesale demathematicization of the high-school curriculum would probably find few advocates.

I take it, therefore, that we shall always wish to treat mathematics in our high-school work as something more than the mere tool or language of science—something which may profitably be studied for its own sake. Nevertheless, in the study of mathematics for its own sake it is certainly possible to take away much of its abstractness and unreality by illustrations drawn from the domain of science. In other words, it is possible and desirable to use science for the sake of fixing and emphasizing mathematical laws just as truly as it is possible and desirable to use mathematics for the sake of interpreting and fixing physical laws. Hence I welcome attempts to interweave the science and mathematics work, particularly in the early stages of the high-school course. The introductory science course which Professor Mead suggests ought to furnish an admirable opportunity to get mathematics and science into more mutually helpful relations than they now occupy. The feasibility of continuing the intimacy of connection throughout the later stages of the course is perhaps more doubtful.

PROFESSOR CHARLES R. BARNES, of the Department of Botany: I have read with interest the article on science in the secondary schools which was put into my hands a few weeks ago. In the main, I think, I agree with its position. The insistence upon establishing a connection between science and mathematics, and bringing the whole of scientific instruction into intimate contact with the child's world and his ideas, is certainly an excellent one.

If there is any criticism to be made, it is that the article has perhaps failed to emphasize sufficiently the difference between scientific training and scientific information. The present failure, as it seems to me, in our secondary schools, so far as science-teaching is concerned, lies in the failure to establish scientific habits of thinking. It is this scientific training in correct reasoning upon adequate evidence that can be imparted by instruction in any science, or, for that matter, in any subject. Up to the time of adolescence a child has relied, perhaps properly enough, upon the method of authority—the authority of the book, of the parents, of the teacher. He ought to begin in the high school to lay aside this crutch and to rely upon the interrogation of real sources of information. I would not deprive him of other sources, nor minimize their importance as short-cuts to probable information; but he ought to learn how knowledge is acquired, and particularly how it is to be tested when occasion arises; and he ought to acquire a wholesome skepticism in regard to "authority."

It seems to me that the article lays stress upon his right to a *body of information*, which doubtless is both useful and interesting, inasmuch as it is interpretative of the modern world. It is much more important that he be stimulated, through interest in the world about him, to acquire a scientific *attitude*, than that he acquire a fund of information more or less accurate. If the latter is to be imparted, it can be done only when adequate time and an adequate teaching force is provided. From time immemorial the child has been given that comprehensive view of the relationship of the history and literatures of

the past to this present epoch. That this has been highly useful goes without saying. When science began to develop, it was simply interpolated or superposed upon the previous courses, or a bit of it was made alternative with them. So "science" was treated as a single subject, co-ordinate with history or language or literature or philosophy or economics. The real co-ordination, however, is between science on the one hand, and humanities, speaking broadly, on the other. If one compares the teaching force and the time devoted to these subjects of human interest and relation, with the corresponding factors in science teaching, it is obvious that the latter is still considered as merely one small feature of the curriculum. When each science stands co-ordinate with each language or each division of history or each literature, then, and then only, will it be possible to give the child his rights in the matter of a comprehensive body of scientific information.

At present I think all that we can hope for is a beginning, which shall have for its object the establishment of a scientific attitude of mind by interested study of natural phenomena in any line which may be permitted by the resources of staff and equipment.

TEN YEARS' INFLUENCE OF THE REPORT OF THE COMMITTEE OF TEN

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A recent article by President Eliot, in support of certain recommendations of the Committee of Ten that had been attacked by President Hall, serves to call attention once more to that committee's report, which was, for some years at least after its appearance, the *sine qua non* of every discussion in the field of secondary-school administration. And the report well deserved the attention that it received. It was the first of the considerable number of reports upon special subjects presented by the National Educational Association, and it set a mark of excellence which it has been hard to excel. It was officially contributed to by a larger number of persons than any other document of a similar character in the whole history of education, and persons, too, than whom there are none better fitted for the work in our country or any other. The report was properly advertised—using that term in its broadest sense—through the method of the committee's appointment; and when it appeared, the teachers of the country were in a state of expectancy that insured immediate attention and the widest reading that has ever been given in this country to an educational document of its kind.

The public has now had the report for a little more than ten years; a brief chapter, to be sure, in the whole great story of educational progress, yet one in which many changes have come about in the schools.

Our educational organism, if I may be allowed the figure from the biologist, is in a condition most prolific of variation, if not sport; and herein lie our greatest hopes as well as our gravest dangers. But with this mere phrase the biological analogy breaks down, for while the biologist must patiently wait for nature to present him with variations, we men of the schools produce them at will.

The conditions that govern us in doing so are many: a peculiar

pedagogical bent, local interests, our own experience in the schoolroom, the experience and advice of others. It is the last of these governing conditions alone that I wish to discuss in this paper, and that solely as it has to do with the advice of the Committee of Ten.

How fully have its recommendations been followed? And as a corollary we might add the query: To what extent are we teachers willing to take advice? And still further: Do we accept it sufficiently to warrant the expenditure of time and labor necessitated by the preparation of a report like that of the Committee of Ten?

The period during which such a report is accepted merely as advice to be followed unquestioningly is comparatively short, and is for this report practically over. As a prophecy—if a valid one—it will live much longer; yet, after all, prophecies, except as they have an influence upon their own fulfilment, are of little real value and of interest only to the curious.

But to return to the direct question: What has been the influence of the Committee of Ten? Or, to state the question in another way, How fully have the changes that have taken place during the last ten years in the high-school curriculum coincided with the specific recommendations of that committee? The method that I have followed in attempting to answer these questions is wholly empirical. It consisted, first, of making a careful study of the curricula of a considerable number of high schools for the years just preceding the issuance of the report in 1895, for the purpose of determining how fully they coincided with the specific recommendations of the report; and, second, repeating the study in all its details at a period ten years later.

If conditions more generally coincided with the recommendations in 1905 than in 1895, it would be logical to assume either that the advice of the committee had been followed, or that the members of the committee were good educational prophets and foresaw the particular paths that were to be taken by educational progress; either would be creditable to the committee. For the earlier period of the study eighty schools were covered: thirty-five in the eastern section of the country, twenty-five in the Middle West, and ten each in the South and far West. For the period a decade later the number

of schools was one hundred and sixty: forty-nine being in the East, forty-six in the Middle West, thirty in the South, and thirty-five in the far West.

Neither these numbers nor the particular schools studied were the result of arbitrary choice, but in most instances of dire necessity. Every available course of study for the years 1892 to 1894 was considered, and this was essentially true for the period ten years later. So far as possible, the same schools were considered at both periods; but, as indicated by the figures, many more schools were included in the later than in the early study. This was that errors due to accidental conditions might be reduced to a minimum. I have not thought it necessary in this paper to give the names of the particular schools studied, but will say that the list includes the high schools of nearly all the larger cities of the country; and that none of the smallest schools are covered is suggested by the fact that only those issuing printed courses of study are included. The part of the study covered by this paper has to do only with those recommendations of the special subcommittees which bear upon the high-school curriculum.

LATIN

The more important recommendations of the subcommittee on this subject were:

1. A full four-year course in Latin.
2. The use of some introductory reading-book before taking up Cæsar.
3. The discontinuation of the study of the *Bucolics* of Vergil.
4. That if Cicero were read before Vergil, only the orations against Catiline be studied then; next Vergil's *Æneid*, and later the more difficult writings of Cicero.

The accompanying table shows the conditions disclosed for the beginning and the end of the ten-year period.

As may be seen from a glance at the table, the recommendations of the committee seem to have carried weight. The percentage of schools offering four years of Latin increased from 46 to 80. The percentage using an introductory reading-book was raised from 10 to 46. In the East and South Ovid, Sallust, and Nepos shared the honor with *Viri Romae*, while in the Middle West the latter and other similar compilations were preferred. The use of the

	1894	1904
Schools with four-year course in Latin	46%	80%
Schools with three-year course in Latin	42	20
Schools with two-year course in Latin	12	0
With introductory books to Cæsar	10	44
With *Bucolics*	26	16
Order—		
a) 1. Cicero 2. Vergil 3. Cicero	25	17
b) 1. Cicero 2. Vergil	38	70
c) Vergil Cicero	32	13

Bucolics was largely reduced—the East seems to have been the only part of the country in which they were in vogue—and the trend was in the direction of the use of Cicero and Vergil, in that order. As to the other recommendations of the committee, which were of a more general character or had to do with details of instruction, little could be told from a study of printed curricula. In schools, however, where less than four years were devoted to the subject it was seldom begun in the first year at either period of the study, so that the recommendation that it be commenced not later than the age of fourteen years is quite generally disregarded. Prose composition seems not to be as generally emphasized as the committee suggests, though when given, it was usually in connection with reading. In two schools, however, for the later study, it comprised all the work in Latin for a term.

ENGLISH

The specific recommendations of the committee are:

1. That the subject of English be taught for five hours a week for the full four-year course in the high school.

2. That three-fifths of this time be spent upon the literature; i. e., three hours per week for the full four years.

3. That three-tenths of the time be devoted to English composition; i. e., two hours per week for the first two years and one hour for the last two years.

4. That one twentieth of the time be devoted to formal rhetoric; i. e., one hour per week for the third year.

5. That the same amount of time be spent upon grammar, but that it come the fourth year.

A study of the curricula of the various schools discloses the following facts as bearing upon these recommendations.

For the period of the early nineties 52 per cent. of the schools were offering the full four years of English, while ten years later the percentage had increased to 68. These figures do not, however, fully show the increase in the amount of English taught, since at the earlier period but 12 per cent. offered more than three years, but less than four years, while for the later period the percentage had increased to 32, giving a full 100 per cent. of the schools with more than three years of English—certainly an encouraging showing.

In the case of the second recommendation we find the tendency in opposition to the advice of the committee, the change being from 30 to 19 per cent. for the three-year period, based upon the number of schools complying. The decrease is not, however, due to a lessening of the number of schools offering more than two years of work in the literature of the subject, but to its arrangement in the course, the tendency being to throw it more completely into the later years of the course. On a time basis alone the tendency is in the direction of compliance with the recommendation, since at the beginning of the period studied but 21 per cent. were offering between 400 and 480 hours—the latter figure being the amount recommended—while at its close the percentage was 55.

The third recommendation is also repudiated in its details by the schools, though it is probable that the difficulty in many instances in distinguishing between composition and rhetoric in the printed courses of study should be taken into consideration. At the close of the period, however, but 8 per cent. of the schools were complying with the recommendation fully, though at its beginning the number was considerably greater. There is, however, a general increase in the number of schools teaching English composition under that name (68 per cent. in 1894, 84 per cent. in 1904), and the amount of time devoted to it is greater. It is both in the matter of the distribution of the subject throughout the course, and in the eighty hours in excess of a single year, that the schools fail to comply with the committee's recommendations. When the entire time of one or more years is devoted to the study of literature, as is true in many instances, the composition is similarly treated, in this

way violating the recommendation for both subjects. That the time devoted to composition is increasing is, however, shown by the fact that at the beginning of the period studied but 16 per cent. of the schools were giving more than a year, but less than one and one-fifth, while at the end 80 per cent. were doing so.

The fourth recommendation shows but little influence upon the schools, roughly 20 per cent. complying at each of the periods studied. Generally speaking, the discrepancy comes from the fact that more rhetoric is offered than was the wish of the committee. In fact, 0.7 per cent. of a year was the average time devoted to the study at the end of the period, in the face of the committee's recommendation of 0.2 per cent. There had been, moreover, a slight increase during the decade.

Little can be said regarding the fifth recommendation. Only a little more than one-third of the schools studied offered grammar as a separate subject, and the percentage had changed but slightly throughout the period.

On the whole, the recommendations of the subcommittee in English seem not to have had a great effect, unless the increase in total time devoted to the subject can be ascribed to it. It must, however, be said that the recommendations were very specific, and it is perhaps not strange that the details have not been followed.

OTHER MODERN LANGUAGES

The committee strongly urged the beginning of such foreign languages as German and French in the grammar grades with pupils of, roughly, ten years of age. Since the conditions were not covered by the printed statements in the high-school course of study, I have nothing to present that bears upon them.

The more important recommendations bearing upon the high-school course in modern language are as follows:

1. If the classics are begun in the high school, modern languages should not be commenced the first year.
2. Otherwise the first modern language should be begun the first year and continued throughout the course.
3. Under the same conditions, the second modern language should be begun the second year and continued.
4. No two foreign languages should be begun the same year.

As to the time devoted to the subjects of German and French —and no other modern language was offered by a sufficient number of schools to warrant generalization—the following table gives the particulars:

GERMAN

	1894	1904
Percentage of schools offering two years	34	25
Percentage of schools offering three years	33	36
Percentage of schools offering four years	33	23
Percentage beginning in the first high-school year or earlier	48	47
Percentage beginning in the second high-school year	30	41
Percentage beginning in the third high-school year	22	12

FRENCH

	1904	1904
Percentage of schools offering two years	40	40
Percentage of schools offering three years	32	40
Percentage of schools offering four years	28	20
Percentage beginning in the first high-school year or earlier	42	44
Percentage beginning in the second high-school year	36	44
Percentage beginning in the third high-school year	22	12

Without discussing the recommendations of the committee individually and in detail, it is plain at a glance at the table that in some very important respects the trend is in opposition to them. This seems due very largely to the development of the elective system in the high school—a move that could not have been foreseen fully at the time the report was written—and also to the introduction of many new subjects which sadly jostled the older ones.

The first thing that strikes the attention is that both for German and French fewer schools offered a four-year course in 1904 than in 1894. Secondly, in spite of the fact that most schools begin Latin in the first year, in which case the committee strongly urges postponement of the modern languages, more schools begin French in that year and about as many German, at the end of the period studied as at its beginning. Thirdly, a larger percentage of the schools begin both the modern languages in the same year—the second—another violation of the recommendation. It should be said, however, that this need not be the case, and probably is not for the individual student—and that, of course, is what the com-

mittee had in mind. The fact is that French and German are both very generally offered as electives in the second year, either to be taken that year and the other the next. In the fourth place, the problem of the fourth modern language was not found to figure prominently, only a limited number of schools offering other than the two mentioned.

MATHEMATICS

The subcommittee on mathematics devoted much of its time to a discussion of the general pedagogy of the subject, yet made a number of specific recommendations:

1. Algebra should be taught throughout the first year and one-half time the second and third.
2. Geometry should be given one-half time for the second and third years.
3. Trigonometry and advanced algebra, one-half time each the fourth year.
4. Bookkeeping and commercial arithmetic, if taught at all, should be optional with algebra the second and third years.

Neither at the beginning nor at the end of the decade covered by my study was the first recommendation of the committee complied with by any considerable number of schools. At its end 31 per cent. of the schools were offering the suggested two years of algebra, while only 15 per cent. were doing so at the beginning, but its arrangement in the course was not that of the committee. It was usually the first two years for full time, or the first full year, with half time the second and fourth. However, the time devoted to algebra was increased about 33 per cent. during the decade.

The committee makes no distinction between plane and solid geometry in its assignment of time. For these two divisions of the subject the place in the curriculum at the beginning and end of the decade studied is as follows:

	First Year		Second Year		Third Year		Fourth Year		Schools Offering	
	1894	1904	1894	1904	1894	1904	1894	1904	1894	1904
Plane	2%	5%	61%	65%	40%	56%	2%	10%	100%	100%
Solid	0	0	7	3	28	31	9	32	43	63

From the figures it is evident that neither subject has a very definitely fixed place in the curriculum. However, in general it

would seem as if the committee had carried weight, for we find the plane geometry pretty generally distributed throughout the second and third years, which were the years recommended. The great increase in solid geometry in the fourth year was not suggested in the report. In the particular schools in which this is done the subject is frequently made an elective with trigonometry and astronomy. Trigonometry was in 1894 offered in 23 per cent. of the schools studied; in 1904, in 44 per cent. It was almost without exception given in the fourth year. Both these facts are in accordance with the committee's report. Similar percentages for advanced algebra are 6 and 26.

The fourth recommendation of the committee had to do with bookkeeping and commercial arithmetic. With the advent of commercial courses these subjects have lost any close affiliation with mathematics which they may once have had, and a discussion of them in connection with the committee report seems out of place.

PHYSICS, CHEMISTRY, AND ASTRONOMY

Of the twenty-two specific recommendations of this committee, but few are of such a character as to lend themselves readily to the method of this study, and are not considered. Those covered are condensed as follows:

1. That physics be taught throughout the last high-school year (200 hours).
2. That chemistry be similarly taught during the third year.
3. That sixty exercises in astronomy be offered as an elective course. A minority report opposes the order of physics and chemistry as stated.

As regards the first recommendation, physics was taught in practically all the schools studied both at the beginning and end of the decade (97 per cent. in 1894; 100 per cent. in 1904). With comparatively few exceptions, too, it was given for an entire year, those exceptions, strangely enough, being in the eastern division of the country. That, however, was only true for the earlier period.

The great variation, both among the schools themselves and from the committee's recommendation, has to do with the exact place in the course that the subject comes. The committee urges the last year of the high-school course; yet that is almost the only year in which it is not found. At the beginning of the period studied the subject was pretty evenly divided between the second and third

years of the course. In by far the majority of the schools physics preceded chemistry, and its place seemed to be determined by the year in which the latter subject came. When chemistry was a third-year subject, physics was a second-year one, with the same relation between the subject in the fourth and third years.

CHEMISTRY

Of the schools covered by my study a smaller percentage were teaching chemistry in 1904 than in 1894, the percentage for those two dates being 66 and 74. This decrease is not, however, strange, nor is it portentous. The period covered by the study is pre-eminently one of increased stress upon laboratory method and laboratory equipment; and doubtless many schools which had been teaching both physics and chemistry with mediocre equipment decided to put one on a proper basis, dropping the other temporarily. This study carried on for another decade would no doubt show that chemistry was coming to its own again.

In the matter of time devoted to the subject, one full year, with very few exceptions, was the constant throughout the decade.

As to the place of the subject in the course little more can be said than that chemistry usually follows physics, coming even then in the majority of schools not later than the third year. It must be said, however, that during the decade that separates the two particular periods studied, the elective system had taken its grip on the high schools, and it is much more difficult to tell just when the science subjects are taken at the later date than at the earlier. In many schools where the subjects of physics and chemistry are electives conditions accidental to the curriculum determine largely the order in which they are taken. In such schools the subjects are usually third-year electives, the one not taken that year following the next. It was impossible to tell from the printed courses of study just what the order of precedence usually was.

On the whole, it would seem as if the minority report of Professor Waggener was more nearly prophetic of the development of physics and chemistry in the high-school curriculum than was the general report. The recommendation of the committee regarding astronomy seems not to have carried weight, since 63 per cent. of the schools

studied for 1894 offered the subject, while but 31 per cent. did so a decade later.

NATURAL HISTORY

The subcommittee on this group of subjects discussed at length the importance of introducing the work in the lower grades, and formally recommended for the high-school years:

1. One full year devoted to botany or zoölogy (not to both together).
2. One half-year devoted to physiology, the work to come late in the course.

For these subjects the conditions are shown somewhat in detail, both as they were found to be taught in the lower grades and in the high school, in the following table:

	Botany and Zoölogy		Physiology	
	1894	1904	1894	1904
Percentage offering in grades	42	74	74	93
Percentage of those offering beginning in grades I-IV	78	97	69	80
Percentage of those offering beginning in grades V-VIII	22	3	31	15
Percentage continuing throughout	33	72	40	58
Percentage giving two periods a week	17	75	60	48
Percentage giving one period a week	83	25	40	52
Percentage giving oral lessons	94	91	69	78
Percentage using textbook	6	9	69	68
Percentage offering in high school	81	77	81	57
Percentage of those offering giving one full year	3	12	..	..
Percentage of those offering giving one-half year or less	97	88	..	..
Percentage offering only botany	48	30	..	..
Percentage offering only zoölogy	9	6	..	..
Percentage offering both botany and zoölogy	43	64	..	..
Percentage giving one- third year	..	..	23	31
Percentage giving one-half year or more	..	..	77	69
Percentage giving in first half of course	..	..	91	86
Percentage giving in second half of course	..	..	9	14

This table, so far as it refers to botany and zoölogy, considers each separately. So far as the work of the high school is concerned, it shows very plainly that the full year of work in one or the other of the subjects was neither generally offered at the time the committee presented its report, nor was it so offered ten years later. There was a slight change for the better during the decade, but at its close only one school in eight was complying with the recommendation. A single term—or, where the semester plan is in vogue, one-half year—is the usual amount. Where but a single one of the

two subjects is offered, the preference is plainly that of the committee, viz., botany. The number offering both botany and zoölogy increased during the decade from 43 to 64 per cent.

There has been a marked decrease in the schools offering physiology, only a little more than one-half studied for the later period including it in the curriculum. It, moreover, remains firmly fixed in the earlier years of the high-school course, which again is contrary to the reommendation of the committee.

HISTORY, CIVIL GOVERNMENT, AND POLITICAL ECONOMY

There is nothing doubtful nor equivocal about the recommendations of the subcommittee on these subjects. So far as they apply to the work of the high school, they are as follows:

1. History should be taught during each of the four years for three periods a week.
2. American history should be included (third high-school year suggested).
3. French history should be included (first high-school year suggested).
4. English history should be included (second high-school year).
5. The fourth high-school year should be devoted to "an intensive study" of some particular period or periods. Greek and Roman history is urged for the year preceding entrance to the high schools, though in a six-year program for historical study it is placed in first year after entrance.

My study of the schools discloses the fact that neither at the time of the appearance of the report nor ten years later were these recommendations even approximated by the actual conditions. At the earlier date but one or two of the schools studied were offering four years of history, and at the later date but 14 per cent.

In 1894 the average time devoted to the subject was 1.3 years; in 1904 it was 2.5. These figures show an encouraging increase, but by no means a compliance with the committee's wish.

The percentage of schools offering the particular divisions of historical study covered by the report, as well as some others not covered, together with the amount of time devoted to each at the beginning and the end of the period covered, are shown by the accompanying table.

There is a marked increase in the number of schools offering American history (57 to 86 per cent.), but at neither end of the period studied was it very generally at the particular place in the course

	1894		1904	
	Per Cent. Offering	Length of Year	Per Cent. Offering	Length of Year
American	57	0.7	86	0.64
French	0	0.0	7	0.50
English	39	0.5	51	0.66
"Intensive"	0	...	5	1.00
Greek	47	0.5	57	0.50
Roman	50	0.5	57	0.50
General	46	1.0	61	1.00

nor in the amount suggested by the committee. In fact, the percentages are but 10 and 17 for the full third year of American history at the extremes of the decade. More frequently the subject came in the first year of the high-school course. French history, at least under that name, hardly figures at all in the course of study, being taught in but 7 per cent. of the schools, and in no one of these for more than one-half year.

The showing for English history is much better. In 1894 about two-fifths of the schools offered the subject for one-half year each, while in 1904 the number had increased to one-half, and the time to two-thirds of a year. At the later date 9 per cent. of the schools were complying in full with the committee's recommendation—i. e., were offering English history for the full second year of the school course. None had been doing so at the earlier date. It is plain from the table that the schools are not yet ready for the intensive study of history urged by the committee; at least, if they are, the fact is not evident from the printed courses of study. It is, of course, possible that the recommendation has had its influence upon the methods of presentation throughout, but this my study would fail to show.

The most discouraging facts of all, from the standpoint of the committee's report, are disclosed by the showing of Greek, Roman, and general history. No one of these subjects was recommended by the committee, except as has already been noted for the first two. Yet at the beginning of the period covered by my study nearly two-thirds of the total time given to history was given to them, and at the close of the period approximately one-half. This, to be sure, shows a change for the better, but none of great magnitude. It is

possible that the slight influence of the entire sub-report on history is partially ascribable to the fact that not long after its appearance the most admirable report of the Committee of Nine fell into the hands of the teachers, thus at least dividing attention. However, at many important points the two committees are in agreement, and their combined effect should have been great.

Under the heading "political economy" the committee made but the single recommendation that the subject be not taught as such in the high school, "but that economic subjects be treated with other pertinent subjects."

The study discloses the facts that in 1894 the subject was taught in 47 per cent. of the schools studied, and ten years later in 43 per cent. At both periods it was taught generally for one-half year during the fourth year of the course. Two schools, however, gave the full year to it. In only one school was it plain that the recommendation that economic subjects be "treated with other pertinent subjects" was being carried out.

The committee offered the following resolution with reference to the teaching of civil government:

> That civil government in the high school should be taught by using a text-book as a basis, with collateral reading and topical work, and observation of the city or town or state in which the pupils live, and with comparisons between American and foreign systems of government.

Regarding the method and content of the work I have nothing to say. As bearing on the first part of the recommendation: In 1894 civics was taught for a full year in no one of the schools studied; for two-thirds of a year, in one school; for one-half year, in 53 per cent.; and for one-third year, in 13 per cent. Ten years later one school offered the subject for a full year; 53 per cent., one-half year; 10 per cent., one-third year. At neither period was there any marked uniformity as to the exact place in the course, though the two extremes—i. e., the first year and the fourth year—were in the lead with the advantage slightly in favor of the latter.

GEOGRAPHY

In this subject the specific recommendations capable of the kind of treatment attempted by this study are as follows:

> 1. That physical geography be taught in the grammar grades.

2. That physiography be taught in the latter half of the high-school course.
3. That geology be elective in the last year of the high-school course.

The facts bearing upon these three recommendations were found to be as follows:

		7th or 8th Grade	1st Year	2d Year	3d Year	4th Year	Total
Physical geography—	1894.....	20%	53%	27%	...	...	100%
	1904.....	6	20	12	...	...	38
Physiography—	1894.....	0	0	0	...	...	...
	1904.....	...	30	18	...	6%	54
Geology—	1894.....	...	...	...	28%	46	74
	1904.....	...	...	5	...	33	38

From the table it may be seen that the subject of physical geography—at least under that name—seems to be going out of the school curriculum. It must be borne in mind, however, that the nomenclature of the schools is not very precise, and it may be that in the decrease in this subject and the increase in physiography we have nothing more than a change in name. Yet it is certain that the committee's recommendation that physical geography be taught in the grades was disregarded by the schools studied, for there is shown a decrease from 20 to 6 per cent. offering the subject in the later grammar grades.

The term "physiography" did not appear upon the programs of any of the schools at the earlier period, though more than one-half the whole number were offering it at the later. The first and second high-school years mark its place in the course.

In spite of the committee's recommendation, geology, too, has fallen a martyr to the over-crowdedness of the curriculum, 74 per cent. of the schools offering it in 1894, to 43 per cent. ten years later. This falling off was largely in the case of schools that had offered the subject in the third year, though the fourth year, the time particularly recommended by the committee, felt the effects of the shrinkage. On the whole, the decade studied showed a material lessening in the number of schools offering any work whatsoever in the subjects covered by the recommendations of this subcommittee.

With the exception of the subcommittee on Greek, which subject was taught in so few of the schools studied as to make generaliza-

tions of little value, this completes the report. And if any further deductions are worth while, the reader is in a position to make them. For my own part, I must confess that the figures prompt me to answer in the negative the question propounded in the earlier portion of the paper. The report of the Committee of Ten seems not to have influenced directly to a marked degree the curriculum of public high schools. This does not mean that it has not fully justified itself through directing thought to the problems of the curriculum and making those problems, so to speak, conscious of themselves; but with the shaping of its details it has had little to do. In fact, more of the specific recommendations of the committee have been actually violated by the trend of high-school organization, or have proved inert, than have been followed. It is difficult to say whether this fact is portentous of good or of evil. It certainly means that we teachers, as a class, are not apt at taking advice—even good advice. But may it not mean, on the other hand, that we have reached a point where the particular problems of our own schools are being thought out on the spot? Schools, like children, do not come most fully unto their own, if advice be too plentiful, or directions from without too incisive. And it may be that the adolescent vagaries even of a high-school system would better be lived through until they find the cure within themselves, than that the external evidence of them be suppressed through too much wisdom from without.

LATIN IN THE SECONDARY SCHOOLS OF GERMANY

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Dresden

A perfect knowledge of some of the standard authors of ancient Rome, based upon thorough grammatical training, and a solid acquaintance with the customs and the civilizations of the "eternal city," are the chief ends and aims of the teaching of Latin in German secondary schools. All that is to be learned from the lowest form up to the highest must be weighed and brought into harmony with these two leading principles.

A very careful selection has therefore to be made of all things that are taught or, more especially, that are to be learned by heart. The selection must limit the subjects of instruction to the very smallest compass, picking out only what is important and characteristic for the Latin language and Roman customs. A sharp distinction, above all, is necessary between those things which the pupil must keep permanently in mind, and those which occur but occasionally in the reading lessons. This prescription refers to the vocabulary as well as to grammar. With respect to the latter, it is a common observation that the rules, the grammatical precepts, are too numerous; that they are formed by the schoolmaster and not, as should be the case, derived from, and selected out of, the classical authors of the "golden Latinity," as we used to call the great era of Roman literature. Only these ought to be taught and learned; the others belong to university students—to philologists, not to pupils.

For the lower form the principal object of instruction is a systematic explanation of the words and forms, and a skilful use of these words and forms in translating. A clear knowledge of the different parts of the sentence (clause) is equally required. The inductive or reform method[1] is employed here, as well as in the

[1] We distinguish between (1) the inductive (analytical) or reform method, which proceeds from the text in the foreign language and leads the pupil to find out the grammatical rules with the help of the teacher; and (2) the deductive or synthet-

higher forms, as long as it furthers the understanding of the pupils and leads them to self-activity. The basis of instruction is the clause. The vocabulary is enlarged as the reading advances. This means a great progress in comparison with the old method of teaching Latin, when thousands of words, absolutely without connection, had to be learned by heart from vocabularies cursed by the pupils, who sighed under the heavy burden. There are vocabularies still in use in accord with the government regulations, but they are not allowed to exceed the boundaries of the Latin reading book. They must be in intimate connection with the subjects treated in the reading-book, and must be arranged according to groups or families, so that many words can be derived from a single root. All that has been read or learned must be constantly worked up by translations, oral or in writing, from Latin into German, or *vice versa*. Particular subtleties of the pronunciation are to be avoided, but the teacher has to try to get a correct pronunciation on the part of the pupils by accentuating very correctly himself, and by paying particular attention to the quantity of the terminations. For the middle classes (fourth form, lower and upper third, and lower second) systematic instruction in the matter of syntax is the chief object of the teaching; the vocabulary is enlarged in the same manner as in the lower form; the translations into Latin are made from an exercise or translation book, in which the vocabulary of the Latin authors that are to be read in the middle classes is worked up. In the higher classes (upper second to upper first) the preservation of the grammatical knowledge required in the middle and lower forms, and its discreet enlargement, are aimed at. The subjects for the class work (translations from German into Latin) must be framed by the teacher himself. They must not be too difficult, but they ought to be of a nature to compel the pupils to think clearly and correctly. If they are selected from passages previously read, they must never be a mere literal translation, so that bright pupils can write them from memory.

ical method, which places the translation from the mother-tongue into the foreign idiom in the center of instruction. The teacher explains the rules, the boy works them up.

As to the reading, grammatical explanations are admitted only if difficult passages require them in order to be understood. The principal thing in reading is a fluent translation into idiomatic German, the clear understanding of the contents of the book, and acquaintance with the life and customs of the Roman people and its great civilizing task. The translation into the mother-tongue must be the common work of the pupils and the teacher during the lessons, but after a certain number of chapters it must be once more given by the teacher as a whole and in standard German. By this means, the use of those abhorred and abominable printed transcriptions which are often found in the hands of the pupils is avoided.

After having finished a work, the teacher has to fix the contents in the pupils' minds by a recapitulation of the principal ideas. He has, besides, to explain the artistic form, the structure of the whole; and if the work was only partly read, the intermediate chapters must be explained, in so far as is necessary to show the connection of the whole. The reading of unprepared passages of a work is not to be neglected. The intimate connection between history and the prose writings of Roman literature is to be shown by a careful and elaborate reading and explanation of historical writers, and especially of the lives of great men from ancient sources. To this end, pictures of classical scenes, monuments and portraits of Roman heroes, must be shown and explained as often as possible. Those pictures—as, for instance, the Forum Romanum, a triumphal arch, the Via Appia, the Roman soldier in full armor—ought to be attached to the walls of the classroom or of the corridors, so that they are ever present to the eyes of the pupils.

As to the plan of studies for successive years we distinguish:

FORM VI

(Eight lessons a week)

Grammar: the regular forms of the nouns, adjectives, adverbs, verbs, and pronouns. The reading and translation book takes its subjects chiefly from ancient history and tradition, so that even in the lowest form a connection exists between these books and the authors which are read in the following classes. A weekly exercise within the class has to be corrected by the teacher; the second half of the year some translations from German into Latin are given as home work.

FORM V

(Eight lessons a week)

Grammar: repetition of the regular forms of the noun, substantives, adjectives, adverbs, and pronouns; deponent verbs; the irregular forms of the nouns and verbs; vocabulary enlarged according to the general views. The exercise book has corrected passages, whereas in the sixth form the single clause prevails. Some of the principal rules of syntax; accusatives with infinitives, participles, ablative absolutes; the double accusative, historical perfect, etc. Exercise in writing as in the lowest form.

FORM IV

(Eight lessons a week)

Four lessons to be devoted to grammar, four to reading. The reading extends to the lives of prominent Greek and Roman heroes according to Cornelius Nepos or a fit reading-book. The preparation for the reading-lessons is made in the class, not at home; the self-activity of the pupils must be awakened; unprepared translations, both from Latin into German and *vice versa*, are made occasionally. Constant exercise in constructions, especially of the accusative with the infinitive, of the participles, and of subordinate clauses; synonymous expressions occasionally; repetition of the so-called irregular verbs; the principal rules of cases, tenses, and moods required for the comprehension of the reading-pieces; translations from the German into Latin from a standard book, the subjects of which are chosen out of the Latin reading, and which serve to fix the grammatical rules; a weekly translation into Latin alternately as home work and as class work; for every term one translation from Latin into German.

LOWER III

(Eight lessons a week)

Four lessons to be devoted to grammar, four to reading. Grammar: repetition and enlarging of the rules of cases, tenses, and moods; translation from an exercise book, the contents and vocabulary of which are chiefly selected from Cæsar's *De Bello Gallico*. Reading: Cæsar, *De Bello Gallico*, I–IV; instruction in preparing lesson; recapitulations; occasionally translating of unprepared passages; synonymous expressions; exercises in writing as in the fourth form.

UPPER III

(Eight lessons a week)

Grammar and reading, each four lessons. Grammar: repetition and enlargement of the rules concerning the tenses and moods; exercise book as in preceding class. Reading: classes, *Bellum Gallicum*, V–VII, and selected chapters from Cæsar, *Bellum Civili*, and from Ovid, *Metamorphoses;* introduction into poetical readings; explanation of the dactylic hexameter and of the principal rules of Latin prosody.

LOWER II

(Seven lessons a week)

Four lessons are devoted to reading, three to grammar. Grammar: repetitions; the syntax of the verb finished; translations as in the middle classes. Reading: easy orations of Cicero (e. g., *Pro Sex. Roscio, In Catilinam, De Imperio Cn. Pompeii*); selections from Livy, first decade; Virgil's *Æneid;* unprepared translations from Cæsar; fine passages from Ovid and Livy are learned by heart.

UPPER II

(Seven lessons a week)

Grammar, two lessons; reading, five lessons. Grammar: repetitions especially of the syntactical rules; instruction on peculiarities of style; translations as in the lower classes, but every fortnight only. Reading: selections from Livy; speeches of Cicero (*Pro Archia Poeta, Pro Ligario, Pro Rege Deiotaro, in Caecilium; Cato Major*); selections from Sallust, Virgil's *Æneid.*

LOWER AND UPPER I

(Seven lessons a week)

Five lessons are devoted to reading, two to grammar. Grammar and exercises as in Upper Second. Reading: speeches of Cicero (*In Verrem*, IV or V; *Pro Plaucis, Pro Setio, Pro Murena*); selections from Cicero's philosophical and rhetorical writings, and from his letters; Tacitus, *Germania* (at least two chapters), *Agricola*, parts of the *Dialogus;* selections from his *Annals* and *Histories;* selections from Horace, some of whose *Odes* are to be learned by heart. Private reading of writers whose works were read in lower classes is desirable, but not absolutely requisite.

The Latin composition, which dominated until about ten years ago, has been abolished; the use of the Latin language in instruction likewise. The latter is to be found still only in some universities in the examination for the degree of doctor of philosophy.

THE TEACHING OF CHEMISTRY IN THE SECONDARY SCHOOLS: A STUDY OF RECENT PRACTICE AND RESULTS[1]

WILLIAM C. GEER

I. INTRODUCTION

During the last few years there have appeared in the educational periodicals a number of articles on the course in chemistry which should be given in the secondary schools. Committees have reported and many methods of teaching have been suggested. These outlines set, let us say, the standards or the ideals of the teachers. It is interesting now to observe in a comparative manner the prevailing practice and the results.

In the fall of 1904 it was my pleasure to read the chemistry notebooks which were presented for entrance to Cornell University, as part of the necessary credentials, by those who entered without examination. Accompanying each notebook was a card upon which were written certain facts about the course pursued by the student. These facts gave data showing the nature and extent of the course. The study of these books and data was the best possible way, short of an actual visitation, to learn the methods and results of secondary-school work. Here were the credentials which the teachers and students were willing to have reviewed as evidence of the quality and quantity of their work. Yet it was not specially done, as for an exposition, but represented the honest, faithful daily work of both student and teacher under ordinary conditions. The data gathered in 1904 were amplified by those from the credentials of 1905, the whole classified and rearranged, and this paper written after the two years' investigation.

No attempt was made to arrange the subject-matter presented, for that was more or less common to all the courses. The time spent on the laboratory work, the character of the record of the

[1] A paper read at the tenth annual meeting of the New York State Science Teachers' Association, December 28, 1905.

experiments, the habits of thought of the students, and the quantitative experiments showed such remarkable diversity that these topics were made the important considerations in the classification.

This paper will include, therefore, first, a study of the time spent in laboratory work, recitations, and lectures; second, the different methods of recording the results of the experiments; third, the literary character of the record; fourth, the scientific character of the record; fifth, the results of certain special features of the course, viz., the quantitative experiments; sixth, some observations and suggestions. Photographs of pages of notebooks are used as illustrations, although in no case is the name of any school divulged.

The schools from which notebooks were received may be classified as follows: (1) schools in New York state—public schools, 83; private schools, 23; total, 106; (2) schools outside New York state—public schools, 76; private schools, 31; total, 107; grand total, 213. The total number of notebooks read was 485.

II. TIME SPENT ON CHEMISTRY

Perhaps the best starting-point in this discussion is a consideration of the amount of time spent in the study of chemistry. In general, three standards may influence the teachers of New York state. First, the report of the Committee of Nine,[1] in which it is stated that the laboratory work should comprise at least 108 hours all told, divided into periods of 1½ hours each and two periods per week; the recitations should occupy two 45-minute periods per week; and the instructor should give one experimental lecture per week.

The second standard is that of the New York State Education Department. In the syllabus of 1900,[2] which prevailed at the time the notebooks here reviewed were written, there is given no definition of the number of hours to be spent in recitation or laboratory. Therefore the work was done under no time limitation. For the sake of comparison with the other standards, it may be mentioned in this connection that in the syllabus of 1905[3] the department

[1] University of the state of New York, *High School Bulletin No.* 7, (1900) p. 714.

[2] *High School Bulletin No.* 8, (1900) p. 117.

[3] New York State Education Department, *Secondary Education, Bulletin No.* 27, (1905) p. 82.

expects of its teachers "laboratory work consisting of exercises requiring 30 double periods of work." This reduces to 45 hours all told, divided into periods of 1½ hours each, and one such period per week. Classroom work and experimental lectures are required, although no number is mentioned.

The third standard is that of the College Entrance Examination Board.[1] This board is general in its statements, but places the lower limit of laboratory work at 40 exercises. There is no numerical definition of the word "exercise." From a study of the 60 exercises listed it is evident that at least 1½ hours are necessary for each. The minimum requirement of the board may then be assumed to comprise 65 hours all told, divided into periods of 1½ hours each, and a few more than one per week.

There can be no doubt that other standards exist, for each college interprets these requirements according to its own ideas. Several of the colleges and universities demand of their entering students a preparation entirely independent of the standards named. No attempt is made to classify the other standards, since they vary but slightly from those mentioned.

Table I shows in what percentage of the schools the work was done in the more common divisions of time. The data are arranged by public and private schools, as the natural and most interesting classification, and since in New York state the private schools probably show the influence of the College Entrance Examination Board, while the public schools are more apt to show the influence of the State Education Department, or the Committee of Nine of the State Teachers' Association. From the tendency of the public schools toward the shorter hours, and the private schools toward the longer, it would seem that these boards have had their influence, although this influence has not been of exceptional moment.

In spite of the emphasis which, during the last five years, has been laid upon a laboratory period of 1½ hours in length, 36.7 per cent. of the public schools of New York state still conduct their laboratory work in 45-minute periods, while only 30.4 per cent. use the double period. In the public schools outside the state the situation is practically the same.

[1] *Document No.* 20, (1904) p. 29.

TABLE I

TIME SPENT IN LABORATORY WORK

HOURS IN EACH LABORATORY EXERCISE	PERCENTAGE OF SCHOOLS					
	Schools in New York State			Schools outside New York State		
	Public	Private	Total	Public	Private	Total
¾	36.7	18.2	32.7	31.6	6.9	24.8
1	22.8	27.3	23.8	15.8	17.2	16.2
1½	30.4	22.7	28.7	26.3	37.9	29.5
2	8.8	31.8	13.8	23.7	34.5	26.7
3	1.3	0.0	1.0	2.6	3.5	2.8
LABORATORY EXERCISES PER WEEK						
1	14.1	18.2	15.0	13.2	20.6	15.2
2	37.2	36.4	37.0	32.9	27.6	31.4
3	23.0	31.8	25.0	32.9	27.6	31.4
4	12.8	9.1	12.0	11.8	6.9	10.5
5	10.2	4.5	9.0	9.2	17.3	11.5
6	2.7	0.0	2.0	0.0	0.0	0.0
TOTAL HOURS						
0–50	8.9	9.1	8.9	2.6	10.3	4.8
51–80	24.0	22.8	23.8	21.1	10.3	18.1
81–100	21.5	4.5	17.8	22.4	10.3	19.0
101–120	19.0	36.4	22.8	22.4	10.3	19.0
121–150	6.3	13.6	7.9	14.5	27.6	18.1
151–300	20.3	13.6	18.8	17.0	31.2	21.0

Less than the double period (1½ hours) is used in New York state by 59.5 per cent. of the public schools, 45.5 per cent. of the private schools, and 56.5 per cent. of all the schools in the state. In the schools outside of New York state the figures are still large; for of the public schools 47.4, of the private schools 24.1, and of all the schools 41.0 per cent. use less than the double period.

Nevertheless, excepting test tube experiments, the period of 1½ hours is none too long for a student to set up the apparatus for such experiments as the quantitative experiments, the preparation of the acids, etc., perform the work thoughtfully, write even the roughest of notes, and take down and put away the apparatus. The majority of exercises outlined by the above-mentioned boards cannot satisfactorily be performed in less than that time. Perhaps some will say that they are using the short period with favorable results.

Evidently many are gaining a species of result, for the number of schools in which this period is used is large; but to do even passable work the boys and girls are driven at such an intense pace that their thinking ability can only be slightly developed. The work in chemical laboratories is conducive to habits of quiet study. Things do not go rapidly. Attempts to rush are usually disastrous. One does not observe off-hand why oxygen is evolved from potassium chlorate. A little thoughtfulness, at least, is necessary. But when excessive speed is demanded, it becomes easy to form the habit of superficial thinking, which is one of the most common and most reprehensible habits which can be formed by the student of chemistry. It then is so easy for him to regard his chemical work as the mere mixing of so much "stuff," with a conesquent play of colors, or an explosion.

It is noticeable that the shorter periods are found among the public schools of New York state more than among any of the other classes named.

The double period is found in New York state in 30.4 per cent. of the public schools, 22.7 per cent. of the private schools, and 28.7 per cent. all told. Outside New York state the figures are not much different, except with the private schools, among which this period is employed by 37.9 per cent. The longer periods are found more frequently among the private schools than the public schools, 31.8 and 34.7 per cent., respectively, finding place for the 2-hour period.

In the second part of Table I it is seen that the majority of schools favor either two or three laboratory periods per week. In some schools there is only one period, and in a very few as many as five or six periods. Two periods per week would seem to be sufficient to give all desired results.

There is even greater diversity in the total number of hours spent in the laboratory. If 100 hours be taken as the dividing line, then in New York state 54.4 per cent. of the public schools spend less than that number of hours on the laboratory work. Outside New York state 46.1 per cent. spend less than 100 hours in the laboratory. Among the private schools the figures are 36.4 and 30.9 per cent., respectively. More time is spent on the work, therefore, outside of New York state than in New York state. Judged accord-

ing to the standard of the Committee of Nine (108 hours), the above figures give the fraction of the schools which do not attain to that standard.

The hours from 151 to 300 may be excluded, on the ground that that amount of time is unreasonable, or not comparable with the standards mentioned. The most rational hours are between 101 and 150, which are found in New York state in 25.3 per cent. of the public schools, 50.0 per cent. of the private schools, and 30.7 per cent. all told; and oustide New York state in 36.9 per cent. of the public, 37.9 per cent. of the private, and 37.1 per cent. of all the schools. These schools meet the standard of the Committee of Nine and exceed that of the College Entrance Examination Board.

Judged by the standard of the New York State Education Department, the public schools of this state more than meet the requirements, since all but 8.9 per cent. show more than 50 hours devoted to the laboratory work. The syllabus, if it be correctly interpreted, sets a minimum standard. To accomplish satisfactory results in a laboratory course is a different question. As already mentioned, this minimum seems altogether too low. No student can derive a suitable training, nor gain a reasonable knowledge of the experimental part of the subject, in 45 hours of laboratory work.

The College Entrance Examination Board and the Committee of Nine recommend a number of experimental lectures to illustrate laws and phenomena, which demand the greater experience of the instructor for their successful demonstration. In Table II it may be observed that in the New York state public schools, to the extent of 58.2 per cent., no such lecture is given; 17.7 per cent. show from 26 to 40 lectures, or about one per week. In the private schools 22.8 per cent. show more than one per week. In 54.4 per cent. of the schools outside New York state no lecture is given. These data may be in error to a certain degree, for some of the teachers may have misunderstood the question. However, it can, at least, be stated that not over 23.7 per cent. of the schools in New York state, and 24.6 per cent. of the schools outside New York state, give experimental lectures as often as once a week, while the lecture side of the course, in 54.5 and 54.4 per cent., respectively, was not of sufficient moment to make any serious impression upon the teacher.

TABLE II

TIME SPENT IN CLASSROOM

EXPERIMENTAL LECTURES	PERCENTAGE OF SCHOOLS					
	Schools in New York State			Schools outside New York State		
	Public	Private	Total	Public	Private	Total
0	58.2	40.9	54.5	52.6	58.7	54.4
1–10	11.4	4.5	9.9	9.2	13.8	10.5
11–25	10.1	18.2	11.9	10.3	10.3	10.5
26–40	17.7	13.6	16.8	19.7	6.9	16.2
41–90	2.6	22.8	6.9	8.0	10.3	8.4
RECITATIONS PER WEEK						
1	1.3	4.5	2.0	10.5	13.8	11.4
2	10.1	22.7	12.9	31.6	20.6	28.6
3	36.9	22.7	33.8	25.0	34.5	27.6
4	17.7	27.3	19.8	13.2	17.2	14.3
5	34.0	22.8	31.5	19.7	13.9	18.1

Evidently the experimental lecture is not popular. The full explanation is not obvious, although several reasons may be assigned. A considerable equipment is needed for lecture experimentation, and this equipment is expensive. Then, again, the teacher's time is pretty fully engaged with routine work, and he is allowed little or no opportunity for the preparation of lectures. It takes time to successfully prepare the apparatus for an experimental lecture, as all who attempt to give such lectures are well aware. Yet this is a fact which is not generally appreciated by the school officers, for many an otherwise ambitious teacher is prevented from developing his course, because he is required to be on duty in classroom or study-hall, when his value to the school would be better conserved if that time were spent in preparing lectures or arranging the laboratory.

In connection with the study of the data on the experimental lecture, it is interesting to notice that where the lecture is weak the recitation is strong. In 34 per cent. of the public schools in New York state there are 5 recitations per week; over 3 per week in 51.7 per cent.; and 3 recitations in 36.9 per cent. In all but 11.4 per cent. there are over 2 per week. The data from the private

schools and from those outside New York state seem to favor few recitations and incline toward 2 and 3 per week.

So far as the notebooks presented by the students from the schools classified above are concerned, it may be stated that in general those from the schools in which the longer laboratory hours prevail show the best results. There are exceptions, but the shorter hours seem to prevent good work.

III. THE METHOD OF RECORDING THE EXPERIMENT

The methods of recording the experiment fall generally into four classes.

In many schools the printed manual is used, and, as Fig. 1 shows, the student is allowed to write his record on the page opposite the

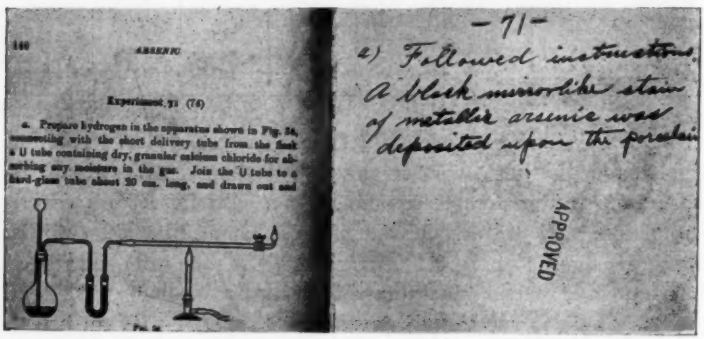
146
ARSENIC
Experiment 71 (74)
a. Prepare hydrogen in the apparatus shown in Fig. 34, connecting with the short delivery tube from the flask a U tube containing dry, granular calcium chloride for absorbing any moisture in the gas. Join the U tube to a hard-glass tube about 20 cm. long, and drawn out and
-71-
a) Followed instructions. A black mirror-like stain of metallic arsenic was deposited upon the porcelain
APPROVED

FIG. 1

directions. The difficulty arises from the ease with which the student forms the habit of writing up the work after the manner just shown. Little benefit was derived in this case. Yet with care in its use it is possible to gain desirable results with the printed manual. The book itself, in whatever way it may happen to be printed, is not of moment. But when the only record consists of perfunctory answers to a few questions, the results are unquestionably bad.

The second method of writing up the notebook is illustrated by Fig. 2. In this form of record, which may be called the tabulated form, the various headings under which the student is supposed

to write the details of the experiment and conclusions are written or printed on the page. Such a plan reduces the work of the student

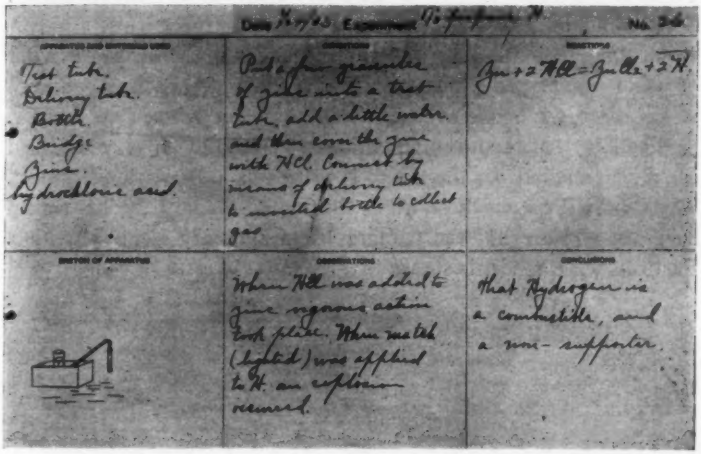
Test tube.
Delivery tube.
Bottle.
Bridge.
Zinc.
hydrochloric acid.
Put a few granules of zinc into a test tube, add a little water, and then cover the zinc with HCl. Connect by means of delivery tube to inverted test tube to collect gas
Zn + 2 HCl = ZnCl2 + 2 H.
When HCl was added to zinc vigorous action took place. When match (lighted) was applied to H. an explosion occurred.
That Hydrogen is a combustible, and a non-supporter.

FIG. 2

to the minimum, he has only to fill in the blank spaces. The plan is pernicious, and the effect upon the student is bad.

The topical arrangement is shown by Fig. 3.

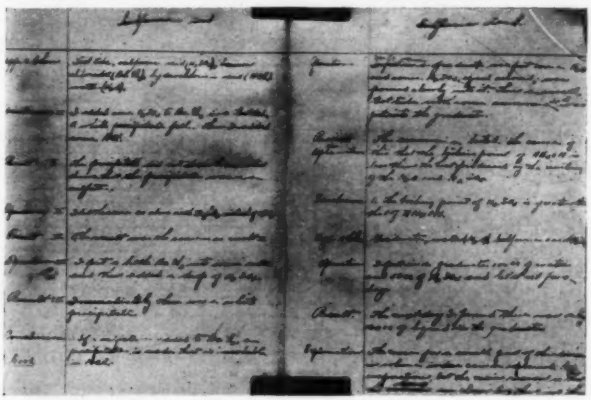

FIG. 3

This is the most common form of notebook. The record is divided into headings: "Apparatus, Operations, Results, and Conclusions," and is similar in some respects to the preceding. Various modifications of this form prevail. If not closely supervised, this method tends to allow the student to drift into the habit of using stereotyped phrases under the different headings. Except in few cases, the books written in this form were not of a high order.

The fourth method is unquestionably the best. It may be called the report method, for the record is written as a clear, simple report. The subdivisions are those which the natural order of the experiment suggests, and are but the paragraphs of ordinary English writing. Part of such a report is shown in Fig. 4.

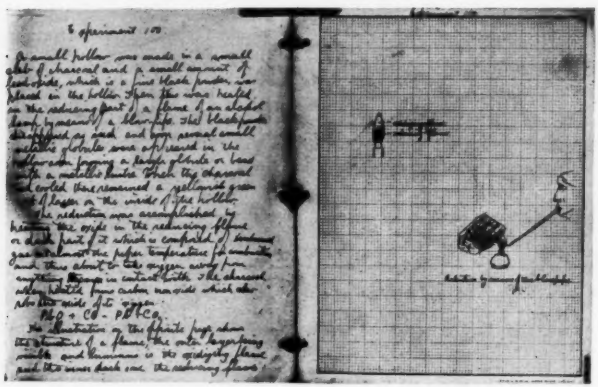

FIG. 4

The advantage of this method lies in the fact that the student is obliged to think connectedly while he writes, and more originality of expression is possible. The emphasis is taken from the operation, and placed upon the clear exposition of the phenomena, and upon the reasoning. Set expressions are avoided, and the teacher is able to render more assistance to the student because his faults stand out more clearly.

IV. THE LITERARY CHARACTER OF THE RECORD

The writing of clear and correct English is a result for which the laboratory notebook affords an excellent training. The teacher

of chemistry and the teacher of English should fully support each other. Drill in the application of a rule may be unpleasant, but with a little care on the part of the teacher the same rule may become an unconscious possession and be used in the writing of an interesting experiment. Teachers of English are often blamed because the students use bad English after their school days are over. It must be confessed, however, that an equal responsibility rests upon the teachers of science who allow the use of expressions which were never learned in the classes in English. If the one teaches the theory of expression, it is the duty of the other to insist upon the correct practice.

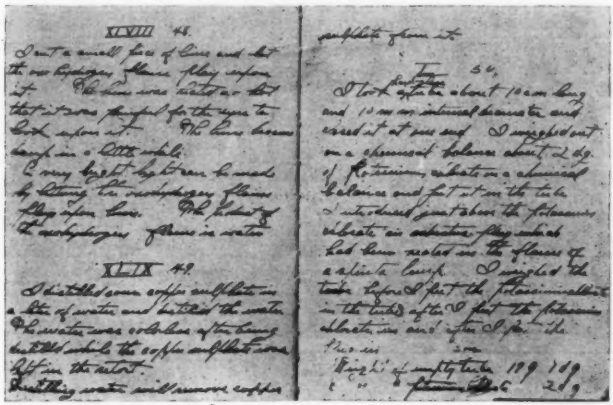

FIG. 5

The frequent use of the first person was one of the common characteristics of the notebooks. Fig. 5 illustrates this point.

Students are often urged by the teacher to use that form of expression. Yet it scarcely needs mention that they are thus confirmed in a habit which is avoided in all good writing. The substance, or the observation, may easily be made the subject of the sentence. It may require more effort at first to teach him to use correct expressions, but he will thereby form habits of lasting value instead of those which will need changing later in life. The use of the first person in laboratory records should vigorously be condemned.

Simply bad English was all too common. The teachers evidently spend little time over the literary character of the reports. The fully written record, which has been mentioned, is conducive to the use of good English.

V. THE SCIENTIFIC CHARACTER OF THE RECORD

The subject-matter of the record will not be discussed here, for it is outside the field of this article. The efficiency of the chemical training, however, is unmistakably demonstrated by the scientific character of the record. By that is meant the sort of reasoning

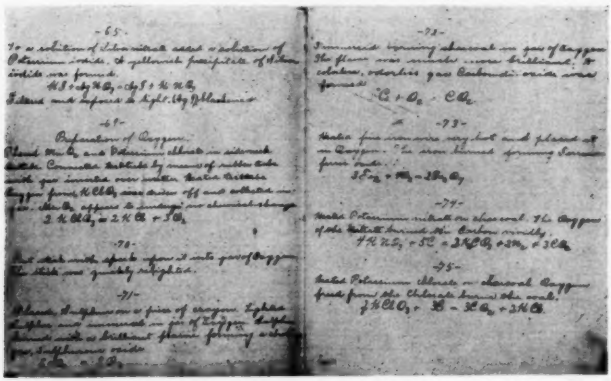

FIG. 6

shown, the pertinence of the conclusions, and the general quality of the work.

Fig. 6 illustrates the copying of direction from the laboratory manual—a fault prevalent among the smaller schools.

In this case the work was of no value to the student, if not of positive mental injury.

The same figure shows another common defect. The equation is made the aim and conclusion of the experiment, with no semblance of connection with the preceding discussion. The equation has undoubted uses, but should never be written by a beginner, except after a full explanation, if possible after a logical derivation; otherwise wholly erroneous ideas are allowed.

Among all the notebooks reviewed the most recurrent error is illustrated by Fig. 7.

An experiment was performed, an observation made, and a conclusion written out, but no sign of a reason to show how that conclusion was reached from the observation mentioned. Since a "conclusion" was demanded, the student "concluded."

To render conclusions from insufficient data is to develop one of the most vicious habits that can be formed. The student could have been honest with himself and written up a fair exposition of the data and only those deductions which were supported by the

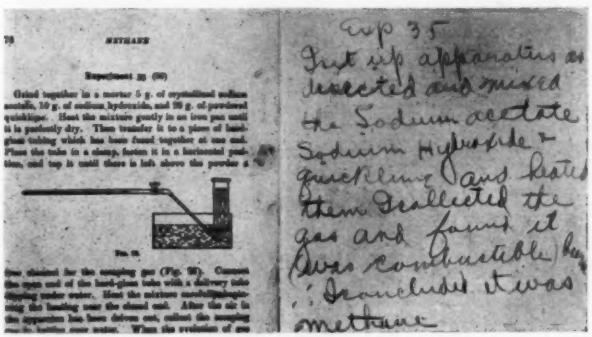

FIG. 7

evidence. If it could have been ascertained that the gas was methane only from the teacher or from a reference work, it would have been better to have explained the experiment thus, and so called attention to the existing conditions. Many experiments do not afford the complete data upon which positive statements may be based. It is well that they do not, for thereby a valuable lesson may be learned in rightly judging evidence. Superficial and stereotyped conclusions lead to habits of thinking that render such study of chemistry of more harm than good.

Fig. 8 shows how the directions given may be made the conclusion.

In sharp distinction from the above is the next figure, Fig. 9, and also Fig. 4.

These illustrations confirm the belief that it is quite possible to

obtain satisfactory results, which are well worth the time and energy expended. The figures shown are not ideal in every respect, but

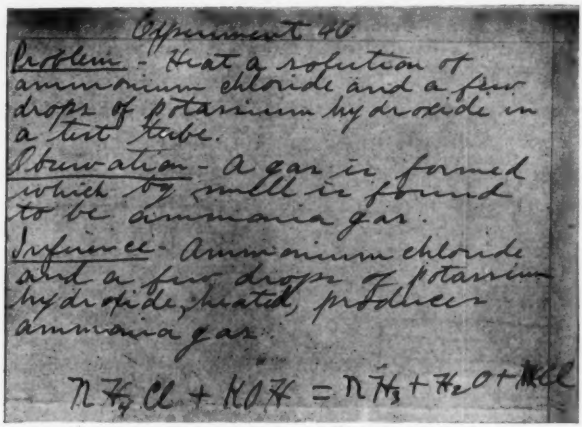
Experiment 46
Problem - Heat a solution of ammonium chloride and a few drops of potassium hydroxide in a test tube.
Observation - a gas is formed which by smell is found to be ammonia gas.
Influence - Ammonium chloride and a few drops of potassium hydroxide, heated, produces ammonia gas.

FIG. 8

they justify the conclusion that good work is promoted by the fully written report.

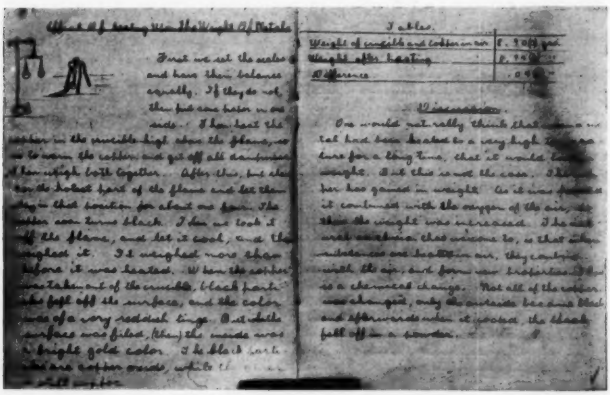

FIG. 9

VI. SPECIAL FEATURES OF THE LABORATORY COURSE

Quantitative experiments have for several years been emphasized by teachers of chemistry. These experiments afford training in measurement and accuracy of observation, and serve to verify the laws which the student would otherwise be obliged to accept as a matter of theory.

The proportion of the schools in which this work is given is an interesting question. In Table III the quantitative and the common

TABLE III

QUANTITATIVE AND PHYSICAL EXPERIMENTS

	Subject of Experiment	Percentage of Schools in Which Experiment Was Performed					
		Schools in New York State			Schools Outside New York State		
		Public	Private	Total	Public	Private	Total
1.	Distillation	15.4	5.5	12.9	17.0	16.9	16.9
2.	Hydrogen equivalent	9.5	33.3	15.7	12.8	25.0	16.9
3.	Ionization	3.8	5.5	4.3	4.3	16.7	8.5
4.	Law of definite proportions	1.9	5.5	2.9	14.9	20.8	16.9
5.	Metal + Oxygen	1.9	11.1	4.3	10.6	4.2	8.4
6.	Miscellaneous	5.8	11.1	7.1	10.6	12.5	11.3
	Oxygen						
7.	Per cent. in air	15.4	27.8	18.6	21.3	12.5	18.3
8.	Per cent in $KClO_3$	11.5	22.3	14.3	10.6	8.3	9.9
9.	Weight of 1 liter	3.8	11.1	5.7	6.4	25.0	12.7
10.	Solubility	13.5	11.1	12.9	19.1	33.3	23.9
	Water						
11.	Decomposition by electricity	23.1	27.8	24.2	23.4	20.8	22.5
12.	H + O by eudiometer	3.8	5.5	4.3	6.4	4.2	5.6
13.	H + CuO	5.8	5.5	5.7	12.8	8.3	11.3
14.	Water of crystallization	11.5	11.1	11.4	10.6	25.0	14.8

physical experiments are classified so as to give the percentage of the schools which include the experiment in their course. The "distillation" experiment is that of the separation of a salt from water. Under "hydrogen equivalent" is included all forms of that experiment. By "ionization" is meant all those experiments which are intended to illustrate that theory. Under "miscellaneous" are included such experiments as the analysis of a carbonate for carbon dioxide. The "solubility" is the usual form of experiment to determine the approximate solubility of the common salts.

In New York state in all but four—viz., 1, 10, 13, and 14—the private schools give these experiments more generally than do the public schools.

Of the schools outside New York state the private schools exceed the public schools in all but seven of the experiments—viz., 1, 5, 7, 8, 11, 12, and 13.

In all but three—viz., 7, 8, and 11—the schools outside New York state exceed those in the state.

In any event, the number of schools in which this important part of the course is given is small. Probably the figures would be larger if computed on the basis of a single experiment.

TABLE IV

HYDROGEN EQUIVALENT

	Weight Metal	Vol. H. c.c.	Vol. H. Corr.	Weight H.	Equivalent	Percentage Error
ALUMINUM (8.93)						
1	0.06	70.3	64.8	0.0058	10.3	15.3
2	0.06	128.85	111.5841	0.09907935	6.2	30.6
3	0.52	605.0	518.09	0.0466281	11.1	24.3
4	0.08	120.0	106.4	0.00953344	8.39	6.0
5	0.0660	90.0	62.8	0.00742	8.97	0.45
MAGNESIUM (12.1)						
1	0.058	60.6	54.7	0.0049	11.83	2.23
2	0.41	420.0	381.0	0.034	11.98	0.98
3	0.089	84.5	76.8	0.006912	12.87	5.8
4	0.220	248.00	228.8	0.02051	10.75	11.2
5	2.0	217.0	200.184	0.1794	11.16	7.7
6	0.026	25.6	23.29	0.00208	12.5	3.3
7	0.05	56.0	49.79	0.0046	11.5	4.9
8	0.3	370.0	310.25	0.279225	10.7	11.6
SODIUM (22.88)						
1	0.906	462.0	438.3	0.039447	22.967	0.39
2	0.723	385.0	346.6	0.03108	23.26	1.7
ZINC (32.45)						
1	0.0257	102.0	92.5	0.00829	31.0	4.5
2	0.205	78.2	71.9	0.006287	32.69	0.74
3	1.0	680.0	575.1	0.0488	30.71	5.4
4	0.23	92.0	80.8	0.00723	31.8	2.0
5	0.2	72.3	66.3	0.00592	33.8	4.2
6	0.2789	101.0	92.94	0.008377	33.49	3.2
7	0.1	37.0	33.2	.....	33.4	2.9
8	0.24	112.0	97.17	0.0087	27.58	15.0

The results which the students obtained with a few of the experiments are shown in the next tables. Table IV gives the results of the hydrogen-equivalent experiment. The first five columns are from the work as found in the notebooks. No attempt was made to correct any errors in that work. In the fifth column, however, it was necessary to recompute the figures, in a few cases, to make them comparable with the other data. Such recomputed data are inclosed in parentheses. The entire sixth column is mine. Inclosed in the parentheses under the name of each metal is the value of the hydrogen equivalent calculated from the atomic weight given in the report of the International Committee on Atomic Weights for 1905.[1]

The table shows that poor work is done, and that good work can be done. The results are evidently the individual work of the student, and show no tendency in any particular school toward any particular results.

From a consideration of columns 3 and 4 a somewhat interesting observation may be made. These columns give the calculations as they were carried out by the students. In only one instance was the metal weighed to four significant figures. In many cases the weight of the metal was expressed in two figures. Yet the calculations in columns 3 and 4 were carried far beyond the limits of experimental error. This is an absurd limit to which to extend calculations. It is better to carry out the computation only to the limit of the accuracy attainable in the experimentation. A training

TABLE V

COMPOSITION OF WATER

H+CuO

	Weight O	Weight H_2O	Ratio H_2:O	Ratio O:H_2O	Percentage Error
			(1:7.94)	(0.888)	
1	0.42	0.48	1:7.0		11.8
2	0.89	1.000	1:8.091		1.9
3	1.0	1.3		(0.770)	13.3
4	20.362	22.905	1:8.007		8.4
5	0.111	0.148		(0.750)	15.6
6	0.910	1.03	1:7.58		4.5

[1] *Journal of the American Chemical Society*, Vol. XXVII (1905), p. 5.

TABLE V—*Continued*

METAL + OXYGEN

MAGNESIUM

	Weight Mg	Weight O	Ratio O:Mg	Percentage Error
			(1:1.52)	
1	0.52	0.33	1:1.57	3.3
2	0.475	0.30	1:1.56	2.6
3	0.29	(0.15)	(1:1.93)	27.0
4	0.165	0.109	1:1.51	0.6
5	1.6	0.87	1:1.84	21.0

PERCENTAGE OF OXYGEN $KClO_3$

	Weight $KClO_3$	Vol. O	Vol. O Corr.	Weight O	Per Cent. O	Percentage Error
					(39.2)	
1	1.52			0.61	40.1	2.3
2	1.75			0.68	39.07	0.33
3	3.67			1.40	38.1	2.8
4	1.62			0.52	(37.1)	5.4
5	1.37			0.544	39.7	1.3
6	0.3365	94.9	84.8	0.1212	35.05	10.6
7	0.25	51.4	47.2	0.067	(26.8)	31.6
8	1.462	420.0	384.78	(.55)	(37.6)	4.1
9	0.2	53.9	49.5	0.08	(40.0)	2.4
10	0.326	95.7	88.905	(.127)	(39.0)	0.51

in judgment is afforded the student if he be taught to choose in each experiment the extent to which he is to carry the divisions and multiplications.

Table V shows the results obtained in some other experiments. The first half of the last part of the table gives the percentage of oxygen obtained by taking the difference in weight between a crucible containing potassium chlorate before and after heating.

The method of the arrangement of the quantitative data in the notebooks may be a matter of some interest. Fig. 10 shows bad arrangement, while Fig. 11 shows excellent arrangement.

VII. CONCLUSION

In conclusion, it may be emphasized that the course in chemistry centers about the laboratory work. The recitation and the experimental lecture have their especial functions to perform, but it is useless to attempt instruction in chemistry without a well-equipped and adequately supervised laboratory.

All things considered, the total amount of time to be spent on laboratory work will depend to a certain extent upon the number of consecutive hours in the laboratory period. If the period is

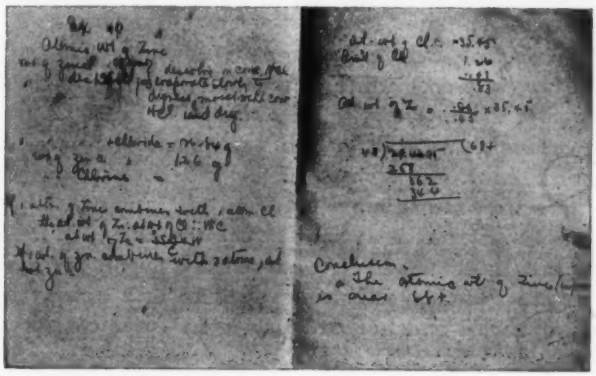

FIG. 10

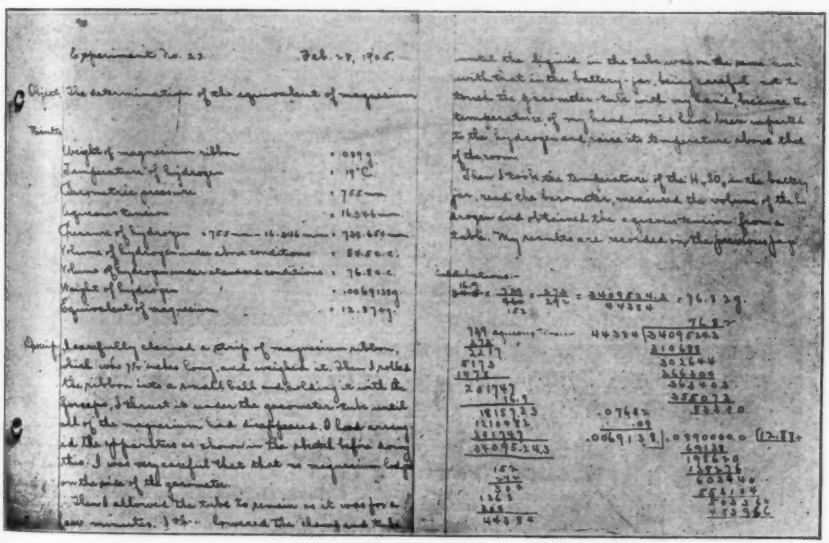

FIG. 11

1½ hours in length, then two per week during 36 weeks will accomplish the desired results. Under such an arrangement the total number of hours for the year would be 108. However, if there be more than 1½ consecutive hours in the period, it will be possible to accomplish the same results with fewer total hours.

The character of the notebook record is a matter of vital concern. The best work is done when the student writes a simple but full exposition of the important features of the experiment, with whatever conclusions are to be derived therefrom, and renders it into clear English. It would be advisable to take only rough notes in the laboratory and write the connected report outside, or at least after the entire experiment had been performed.

Emphasis should be laid on the use of good English in the record. The reasons for every conclusion should be fully stated, and the experiment should be interpreted only so far as the conditions and data warrant.

Quantitative experiments are recommended, and the calculations involved should be carried no farther than the limit of accuracy with which the weighings and readings are made.

If the students are well prepared, chemistry can be taught successfully in the high schools. To do so it is necessary to equip the laboratory adequately with desks and apparatus; to allow the students to work in periods of not less than 1½ hours in length; to arrange the teacher's time so that it will be possible for him to prepare experiments and carefully to supervise the laboratory; and for the teacher himself to be well educated and to keep alive to the developments of this progressive science.

The lack of uniformity among the schools is quite remarkable. This may be due to the difference of opinion on the part of the leading educators over the methods to be employed and the time to be given, but more probably the difference is due to the lack of equipment in the schools, which renders chemistry of less importance in the school curriculum than other subjects, and hence less time is allowed to it. Perhaps, also, the school officers do not appreciate the value of chemistry, and so make little or no effort to arrange the school program so as to accommodate a laboratory period of more than 45 minutes in length. Whatever may be the

cause of the conditions, there is need that greater attention be given to chemistry by many schools, if the grade of work is to be high, and there is need that the teachers teach with reference to an ideal standard, rather than merely to pass their pupils over a "minimum requirement" set by some examining board.

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A MODERN ROMAN STATE

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During the past three years an interesting experiment has been going on in the East High School of Rochester, N. Y., and its complete success has well repaid the time and effort devoted to it. We have reproduced, as completely and accurately as a limited number of pupils would permit, the ancient Roman political organization, with its attendant campaign and election.

The experiment was the result of an effort to find some aspect of Roman life into which the pupils in Latin can at once appreciatively and sympathetically enter. Unquestionably, one of the chief obstacles in the study of Latin has been the utterly strange and foreign atmosphere into which the pupil is plunged on the first day he takes up the subject, and which he usually continues to breathe so long as he studies it. This feeling of unreality, the belief he unconsciously acquires that the Romans were an unnatural people, quite distinct from the type he sees about him, talking in long periods, on subjects quite outside his natural, everyday interests, in a language artificial and difficult, destroys all possibility of real, personal interest, and consequently of securing the best results from the study. It is our aim to have every pupil, upon beginning Latin, become a member of a Roman state, and to create an atmosphere in which Latin is the natural means of expression.

We may give illustrated lectures on the private life of the Romans, but this, while excellent so far as it goes, does not bridge the gap between the mind of a fourteen-year-old boy or girl of 1906 A. D. and the civilization of Rome two thousand years ago. Pupils are assuredly interested in such lectures, but it is the same antiquarian interest that they might feel in some extinct species of mankind of which curious traces have been found, and not the live, personal interest that should accompany the study of the language of those Romans whose works occupy such prominence in their education.

Descriptions of Roman life are enlightening only provided the student has already found some door by which he can really enter into the spirit of ancient life, no matter in what phase. Interest excited by pictures is external and superficial, unless significance is given them by some common bond already existing and joining the active, real life of an American boy with the no less active and real life of the Romans.

Reproductions of Roman plays, trials, festivals, etc., however valuable and interesting in themselves, are, by their nature, only occasional, and affect directly but a small proportion of pupils, while the remainder are passive spectators, in whom curiosity is usually the predominent feeling. What I have been searching for is an interest both continuous and self-sustaining, and which can, by its continuity, give background and coherence to other interests by themselves isolated or spasmodic, and be the natural source from which they spring.

Now, by the very nature of the government under which we grow up, by the familiarity and instinctive interest felt by every American boy or girl in elections and politics, it seems as if the political phase of Roman life would be the first to suggest itself, as readily comprehensible and naturally interesting. That our Roman election has excited just that interest will be readily apparent to any visitor at the East High School. When anything connected with their study of Latin so arouses their interest that rival parties hold mass meetings attended spontaneously by half the Latin pupils at the same time; when pupils busy themselves writing in Latin the political platforms of the recreated ancient parties; when blackboard space and wall space in corridors and assembly hall is at a premium for the posting of Latin inscriptions in support of one candidate or another; when the display of the colors of opposing parties rivals the school colors even in the height of football enthusiasm, we can feel assured that in the political contests of ancient Rome has been found the common bond of interest for which we were searching.

In the following pages I shall describe in detail the organization of the state, the campaign, the election, and the functions of the officials. It must be borne in mind that in the actual conduct of the state these several aspects are inseparable. The intricate political

system is brought into existence through the interest and excitement of the campaign, while the functions of the officials are illustrated at every stage of the proceedings. The election itself is the central point of interest during the year, exhibiting vividly, as it does, all the machinery of government in actual operation, forming a climax in which culminates the strenuous party rivalry of the preceding campaign, and affording opportunity for practical illustration of the most important duties of the state officials.

The organization here described is the developed and permanent form reached in the third year of our state. Each year has required a complete reorganization, owing to the addition of pupils not previously included, but now every Latin pupil is a member of the state, and no further changes will be needed, except such as are due to the annual graduation of one class and the entrance of another. I shall describe the procedure of this year, where we made constant use of the officials elected the previous year by the smaller state.

There are about twelve hundred pupils in the school, of whom eight hundred and fifty study Latin. Mid-year graduation is in operation, producing eight grades of Latin work, designated as "Latin term," "Latin final," "Caesar term," "Caesar final," "Cicero term," etc.; and forming in all twenty-nine sections. The first step in the organization of our Roman state was the creation of trade guilds (*collegia opificum*). Each of the twenty-nine sections represents one of the following *collegia*, assigned by lot:

agricolae (market-gardeners)
aliari (garlic-dealers)
aurifices (goldsmiths)
caupones (innkeepers)
cisiarii (coachmen)
clibanarii (confectioners)
coeparii (grocers)
cornicines (horn-blowers)
culinarii (cooks)
fabri (carpenters)
forenses (hucksters)
fullones (fullers)
gallinari (poultry fanciers)
libari (pastry cooks)
librari (librarians)
lignarii (wood merchants)
muliones (mule-drivers)
offectores (dyers)
perfusores (perfume merchants)
pilicrepi (ball-players)
piscicapi (fishermen)
pistores (bakers)
plostrarii (blacksmiths)
pomari (fruit-dealers)
saccarii (porters)
sagarii (dry-goods merchants)
tibicines (flute-blowers)
tonsores (barbers)
unguentarii (druggists)
vestiarii (tailors)

Each *collegium* selects from its members a *princeps*, or president, who in turn appoints four *magistri*, or master-workmen. The remainder are *discentes*, or apprentices. The room in which they recite becomes their *curia*, or local place of assembly, and other related ideas are gradually introduced, such as the drawing-up of rules of membership, the choice of a patron deity and of a Roman *patronus*. The idea that vast numbers of Roman citizens were laboring-men, organized in labor unions, living their lives as naturally as do their modern representatives, comes as a gratifying surprise to the average pupil, and forms a welcome corrective of the unfortunate impression made by the vocabulary of his first-year book, and intensified by the texts read later, that the Romans were a curious and ethereal people, spending their lives in attacking towns, making speeches, attending banquets, and watching games. And when he learns that the guild of carpenters (*fabri*), of musicians (*cornicines*), and others antedate the Roman Republic and even history, he gains a new idea of the antiquity of these institutions and their accompanying problems. The pupils are expected to learn the names of a number of the guilds, especially of those meeting in their *curia*, and to understand in general their organization and purposes, the result of which is a good conception of the condition of labor in ancient Rome and of the extent to which division of labor existed. Prose work of a much more natural type, and of much greater inherent interest, than the usual stereotyped form can easily be devised, thus giving the whole a unity of purpose and attaching it directly to the daily progress of the pupil.

While the ancient *collegia* were not strictly political in their nature, their active participation in the elections makes the introduction of them into our state highly desirable, and their convenience as instruments for organizing the state itself makes them indispensable. Much stress was placed on the selection of energetic *principes*, of executive ability, and they assumed the burden of forming the state. Each *princeps*, assisted by his *magistri*, assigned to every member of his *collegium* a Roman name with its three parts. To the Vergil classes were assigned the names of the chief writers living, with few exceptions, from about 133 B. C. down to Augustus. Following is the list selected, though numerous additions can be readily made:

L. Livius Andronicus
Cn. Naevius
T. Maccius Plautus
Q. Ennius
M. Pacuvius
P. Terentius Afer
M. Porcius Cato Censor
M. Porcius Cato Uticensis
C. Lucilius
Q. Tullius Cicero
M. Terentius Varro
C. Julius Caesar
C. Cilnius Maecenas
C. Cornelius Nepos
T. Lucretius Carus
C. Sallustius Crispus
C. Valerius Maro
Q. Horatius Flaccus
A. Albius Tibullus
Sex Propertius
P. Ovidius Naso
T. Livius
M. Vitruvius Pollio
M. Tullius Tiro
T. Pomponius Atticus

To the Cicero classes are assigned the names of the prominent political leaders from 133 B.C. to Augustus, as follows:

Ti. Sempronius Gracchus
M. Octavius Nepos
C. Sempronius Gracchus
L. Opimius
C. Marius
L. Apuleius Saturninus
C. Servilius Glaucia
M. Livius Drusus
P. Sulpicius Rufus
L. Cornelius Sulla
L. Cornelius Cinna
Cn. Octavius Nepos
M. Aemilius Lepidus
Q. Tullius Cicero
M. Tullius Cicero Junior
M. Tullius Tiro
T. Pomponius Atticus
P. Cornelius Lentulus Crus
Q. Junius Silanus
M. Porcius Cato
Cn. Pompeius Magnus
M. Licinius Crassus
C. Julius Caesar
A. Gabinius
Q. Lutatius Catulus
M. Calpurnius Bibulus
T. Annius Milo
P. Clodius Pulcher
M. Antonius Triumvir
C. Scribonius Curio

To the Caesar classes are assigned naturally the names of contemporaneous military leaders and lieutenants of Caesar. The leaders of the civil wars are included.

Q. Caecilius Metellus Numidicus
C. Marius
Cn. Pompeius Strabo
L. Cornelius Sulla
Cn. Pompeius Magnus
M. Licinius Crassus
Q. Sertorius
Q. Caecilius Metellus Pius
C. Julius Caesar
C. Valerius Procillus
T. Attius Labienus
P. Licinius Crassus
Q. Titurius Sabinus
L. Aurunculeius Cotta
P. Sextulus Baculus
C. Volusenus Qadratus

L. Africanus
M. Petreius
L. Domitius Ahenobarbus
M. Junius Brutus
D. Junius Brutus
D. Cassius Longinus
M. Antonius Triumvir
C. Julius Caesar Octavianus
M. Vipsanius Agrippa

Beginning Latin pupils were assigned any of the above names indiscriminately. The concrete individual name once learned is made a basis for an explanation of the Roman name incomparably clearer than any other could possibly be. Each pupil retains his name for a year, and is expected to investigate the life of the man whose name he bears, to learn the names of some of his classmates, and thus gradually to become acquainted with the names and deeds of the men of the period selected, the last century of the republic. This period was chosen because it is, in comparison with preceding centuries, pre-eminently a study of individual lives. The differentiation into three classes—military, political, and literary—is not introduced till the second year, both because this division is made natural only by the characteristics peculiar to the texts read in the last three years, and because it was thought sufficient to secure in this field during the first year merely a clear understanding of the formation and significance of the name itself, with some familiarity with the names of those in the same class, postponing till the second year the study of the individual lives. Some very good papers, purporting to be letters or speeches, have been written by third-and-fourth-year pupils, describing their own lives in the first person, with numerous references, humorous and otherwise, to their contemporaries. In these papers pupils have carefully followed the main lines, as prescribed by such facts as are known, but within these limits have given their imagination free rein. We are gradually preparing tables of references to our library, by which this idea can be more easily developed, and the pupils introduced into a field of valuable and interesting reading. It follows that, since the lists of names are limited, several must bear the same name, but they are never in the same class, and as they are, furthermore, always assigned to different tribes, the full official names of five parts are all different. Pupils are encouraged to use their Latin names in addressing one another—a habit no less valuable because it is regarded as a

joke. The declension of the name and of numerous words related thereto—*nomen, gens, familia, stirps,* etc.—forms a group of paradigms in which they take a greater interest, since their significance appeals to them directly.

When the pupils have received their Latin names, they are classified as citizens either by birth, by naturalization, or by manumission, with the largest number in the first class. This classification forms the basis for an account of Roman society immediately intelligible to each pupil and supplementary to what he learned from the *collegium.*

The pupil is then successively enrolled in the four great political units of *curia, tribus, classis,* and *centuria,* on the basis, respectively, of birth, geography, wealth, and age.

Birth is represented by scholarship, and on that basis each pupil is made a patrician or plebeian. Of our eight hundred and fifty citizens, ninety are patricians—a number chosen to secure a multiple of three, the number of patrician tribes, and of thirty, the number of *curiae* in these tribes. These ninety patricians are divided into the three tribes of Luceres, Ramnes, and Tities, and each tribe of thirty patricians into ten *curiae,* to which the ancient names, so far as they are known, are assigned. Each *curia* elects its *curio,* and the thirty *curiones* a *curio maximus.* They assemble in this form as a *comitia curiata,* and after the election confer the *imperium* by a formal act upon the officials chosen by the popular assemblies. It is thus the earlier form of the *comitia curiata,* composed solely of patricians and wielding a really effective power of ratification, that we have adopted. The list of ninety patricians is revised and published every year by the censor after conferring with the various instructors. It is so arranged that the proportion of patricians increases from one in twenty-five in each beginning Latin class to one in three in each "Vergil final" class.

The division into five classes on the basis of wealth is represented by the division into several grades on the basis of year. The Vergil classes represent the *prima classis;* the Cicero classes, the *secunda classis;* the Caesar classes, the *tertia classis;* the "Latin final" classes, the *quarta classis;* the "Latin term" classes, the *quinta classis.* Care must be taken that there are at least seventy pupils in each di-

vision. Of the Vergil classes the "Vergil final" section represents the *Equites Romani equo publico*, while a small section of beginning pupils represents the *capite censi*, a class below the *quinta*. The arrangement was made in such a way that the size of the classes increased as the property requirement decreased. Property to a definite amount is assigned to each citizen within the limits prescribed for his *classis*, as follows:

Equites, 1,000,000 asses	$20,000
First class, 100,000 asses	2,000
Second class, 75,000 asses	1,500
Third class, 50,000 asses	1,000
Fourth class, 25,000 asses	500
Fifth class, 1,500 asses	33
Capite censi, below	33

The natural division of Roman citizens into *centuriae* of *juniores* and *seniores* on the basis of age is represented by the division into boys and girls, the latter forming *centuriae* of *juniores* (seventeen to forty-five years of age), and the former the *centuriae* of *seniores* (forty-five to sixty).

For the fourth division into thirty-five tribes, on a basis more or less geographical, there could be no natural representative; for each tribe must contain both *juniores* and *seniores* from all five classes. To secure this result, and at the same time to equalize the numbers in the tribes, the several *principes* were instructed to begin at different points in the alphabetical lists of tribes, and assign one boy and one girl to each tribe in order, until the *collegium* was exhausted. This process insured the formation of thirty-five tribes each composed of from twenty to thirty members, comprising representatives from each of the five classes, and equally divided between *juniores* and *seniores*. As soon as a pupil received his tribal assignment, he incorporated in his name the abbreviated name of his tribe, as follows:

Aem.	Cor.	Mae.	Pom.	Stel.
Cam.	Fal.	Pal.	Rom.	Tro.
Ani.	Lem.	Pol.	Ser.	Vot.
Cla.	Esq.	Men.	Pup.	Sub.
Col.	Gal.	Pap.	Sab.	Vel.
Arn.	Fab.	Ouf.	Quir.	Ter.
Cru.	Hor.	Pop.	Sca.	Vol.

At the same time he is given one of the following Italian towns as a place of residence, with some effort to give each tribe a geographical center:

Alba Longa	Capua	Neopolis	Roma
Ancona	Cannae	Nola	Sena
Antium	Canusium	Ocriculum	Stabii
Arpinum	Circei	Ostia	Tarquinii
Arretium	Clusium	Perusia	Tarentum
Baiae	Corfinium	Pompeii	Thurii
Beneventium	Croton	Praeneste	Tusculum
Brundisium	Cures	Puteoli	Veii
Caere	Fregellæ	Reate	Venusia
Caieta	Gabii	Rhegium	Volaterra
Cales	Minturnæ		

A map of Italy before the pupils, and an occasional question, will secure during the first year considerable knowledge of Italian geography, and where the ancient town possesses sufficient historic interest, pupils are encouraged to study its history and find out what remains of it have been found. The tribal and municipal assignments are permanent for the four years of the high-school course.

Each pupil is now in possession of such facts concerning himself as are necessary to direct his political activities, and at the completion of the last step he is presented with a card summarizing them all.

NOMEN FORMALE

P. (PRAENOMEN)	*Sulpicius* (NOMEN)	*P. b.* (PATER)	*Aem.* (TRIBUS)	*Rufus* (COGNOMEN)

NOMEN TRIPLEX *P. Sulpicius Rufus*

I. ORDO *Patricius–Ramnes*

II. TRIBUS *Aem.* MUNICIPIUM *Praeneste*

CURATOR TRIBUS

TRIBUNUS AERARIUS

III. CLASSIS *Secunda* 82,500 ASSES

IV. CENTURIA *Senior* 52 ANNOS NATUS

CENTURIO

COLLEGIUM *Culinarii*

PRINCEPS *T. Pomponius Atticus*

When the citizens have thoroughly mastered their political status in *curia*, tribe, class, and *centuria*, the various political assemblies

based upon them are organized. The *comitia curiata* has already been mentioned, but as its functions are the least important of all, and its organization might confuse the pupils, it was postponed to the last. The *comitia centuriata* was organized on the reformed tribal basis, with eighteen *centuriae* of *equites*, seventy *centuriae* in each of the five classes, and five extra *centuriae* of *cornicines*, *tibicines*, *fabri*, *accensi*, *proletarii*, known collectively as *capite censi*, making three hundred and seventy-three in all. The *comitia* meets in the assembly hall, with the *equites* in the first rows, separated from the *prima classis* by a vacant row, and the *prima* from the *secunda* etc. A perfect picture of such an assembly, and of the conditions it represents, may be left in the minds of the pupils by causing the various classes to rise in succession. Many *centuriae*, especially those of the *prima classis*, consist of but one citizen, who in that case is the *centurio* also. Where the centuria consists of two or more, a *centurio* is chosen, and the three hundred and seventy-three *centuriones* present a clear object-lesson in the method of voting in this assembly, where each *centuria* casts one vote through its *centurio*. The assembly thus organized is presided over by those officials competent to do so, and its functions are illustrated by the business brought before it. Each year the pupil, as his property increases, will advance till he reaches the seats assigned to the *equites*.

I adopt the view of two tribal assemblies—the *comitia tributa* composed of patricians and plebeians, and the *concilium plebis tributum*, composed solely of plebeians. The former organizes first. The *aediles*, upon whom such a duty naturally falls, carefully plotted the assembly hall, and assigned to each tribe an exact and permanent location. After the evolution had been practiced once or twice, five minutes proved sufficient to change from a *comitia centuriata* to a *comitia tributa*, with each of the thirty-five tribes isolated by a row of vacant seats about it. A roll of the tribes gives an accurate impression of this organization, with each tribe divided into ten *centuriae*, five of *juniores* and five of *seniores*. The officials capable of presiding illustrate their powers by practical exercise, and the functions of the assembly are shown in a similar manner. Each tribe elects a *curator tribus*, who has charge of the tribe at elections, and a *tribunes aerarius*, who collects what funds are needed.

The second tribal assembly, composed only of plebeians, the *concilium plebis*, is formed by merely asking the patricians to withdraw, and the plebeians remain organized by tribes.

This completes the formal organization of the state. From the very first it was found impossible in any appreciable degree to modify the complicated organization of ancient Rome and still convey a correct idea of it. When, however, we secure a thorough grasp of the organization by all Latin pupils at one time, each successive entering class will be absorbed and assimilated into it. The initial leavening of the whole lump is the serious difficulty, and is accomplished best by gradual stages, either by beginning with the classes of one or two instructors, or by initiating each successive beginning class, and waiting four years for the process to complete itself. Success depends upon the interest of the pupil; his interest depends on his understanding, and nothing could be more useless than to put an inert mass of pupils through motions, the significance of which is lost upon them.

EDITORIAL NOTES

NEEDED SCHOOL LEGISLATION

Superintendent F. D. Boynton, of Ithaca, N. Y., in his presidential address before the New York State Teachers' Association last December makes a forcible appeal for certain legislation reforms. The two facts which call for attention are the absence of men teachers and the large proportion of teachers who remain but a short time in the profession. "The former evil," as he justly remarks, "is not due to the competition between men and women." "The competition is not between men and women for the small and not overripe fruit of the educational tree, but between the school business as a business with other forms of business activity competing for both men and women who are able to assume and discharge large responsibilities."

The second evil is less talked about in the public press, but it is no less patent. "The annual influx of 43 per cent. of new men into teaching, the fact that only 27 per cent. of the total number of men engaged in teaching in a neighboring state have had even three years of experience, are indications of a prevailing unrest among teachers, and show that the schools are largely in the hands of novices, without experience and with no present intentions of remaining in the business, no matter what their plans may have been at the time of entering."

SPECIFIC REFORMS

The reforms Superintendent Boynton advocates to meet the above evils are: (1) appointment upon merit alone; (2) appointment without limit as to time after a satisfactory probationary period has been successfully passed; (3) freedom from meddlesome and unprofessional interference in the discharge of duty; (4) increased remuneration, approaching that of other learned professions; (5) pensions for old age, to which the beneficiaries shall have contributed.

"The first is generally conceded, and in an increasingly large ratio appointments are first made upon merit. The second demand is not as universally recognized, but in the opinion of the New York State Council of School Superintendents, and of a large and growing number of educators some form of a tenure-of-office law is necessary for the immediate future welfare of our schools. So far as I have been able to learn, no good reason has yet been given why a teacher who has satisfactorily passed a probationery period should not be secure in his position so long as he continues to discharge his duties faithfully and efficiently, providing, however, that his character shall remain above reproach. That this is not the case, the advocates of tenure assert, is abundantly established by available statistics, and to this fact alone they attribute the constant change and unrest from which our schools continually suffer. On the other hand, the opponents of tenure claim that a teacher is now secure just so long as he faithfully and efficiently discharges

his duties as a schoolman, and as such he is free from political, social, fraternal, and religious interference. If we grant our opponents' position, then, as progressive educators, they should readily consent to the removal of a form which they themselves assert has lost its substance.

"But men leave the school business because of its uncertainties. Security in one's position, while actively and aggressively engaged in education, is of prime importance. Repeated and continued annual elections are not only an evidence of bad faith, but are as antiquated as the *a b c* method of teaching reading, or as the stage-coach as a means of travel—suited only to a pioneer period. Dismissal without sufficient cause, and without giving the accused a fair hearing, is un-American; it is the factory method of dealing with the 'hands'; and if it is to be continued, the teachers of this state should get ready to meet such treatment as factory hands meet it."

It is obvious that two aspects of reform of education ought to go hand in hand. We cannot afford to adopt measures which will confirm teachers who never ought to have been appointed. But, on the other hand, it is certainly true that a good teacher ought to be secure to do his work. The present writer is somewhat familiar with certain of the older academies in New England. They have no difficulty in securing men as teachers. They frequently can not keep them as long as they would like, because they can not pay them adequate salaries; nevertheless, they secure men teachers in larger proportion for the same salaries than do the public schools in the vicinity. One important reason for this is without doubt the permanency of tenure. The general method followed by colleges seems to meet the situation. Appointments in college positions are usually made at first for one or two years; then for a longer period. Appointment to a professorship is almost universally recognized as permanent. The colleges secure men; frequently they secure them at lower salary than is paid in the public schools. Unquestionably the element of permanence bulks largely in the greater attractiveness of the college position, although, of course, other elements are found there as well. We wish the New York teachers success.

BOOK REVIEWS

Bench Work in Wood. By W. F. M. Goss. Boston: Ginn & Co., 1905. Pp. xiv+200. $0.70.

This book is an old friend in a new dress. Part I describes many of the tools used by woodworkers, and explains the common methods employed in caring for and sharpening these tools. Unfortunately, however, many of the tools described are obsolete; and others are of such clumsy make and poor material that they should not find place in a work of this kind. The space would be better employed in describing the best tools rather than those that are clumsy and out of date.

Part II consists of a series of well-chosen exercises calculated to familiarize the student with the tools and to give him some facility in their use. It is an open question how far mere exercise work should be carried. Many of the principles illustrated could just as well be applied to the making of articles for actual use, and thus lead to the solution of problems that arise in the experience of the pupil. Such work is of greater value than that which is cut and dried, as in the case of an exercise. Drawboring is described with some minuteness, and then the author says it is bad practice. Why waste time telling how a piece of work should not be done?

Part III treats of wood construction as applied to carpentry and joinery. Part IV treats of timber and its preparation for use. Many kinds of wood are described, and their geographical distribution in the United States is represented by charts.

The book is profusely illustrated, but many of the cuts would be better if the excessive shading were omitted. Too many shade lines tend only to confuse those not familiar with mechanical drawings, and are superfluous. The book is well adapted to beginners in the art of wood-working, and has many valuable suggestions for those who are farther advanced in the subject.

WILBERT S. DREW.

MANUAL TRAINING AND TRADE SCHOOLS,
Pontiac, Ill.

Physics. By CHARLES RIBORG MANN AND GEORGE RANSOM TWISS. Chicago: Scott, Foresman & Co., 1905. Pp. x+453. $1.25.

This book is noteworthy among recent texts on elementary physics because it is the first successful attempt to break away from traditional lines by bringing about an intimate correlation between the subject-matter of physics and the activities of daily life. The newness of the treatment lies in its constant appeal to the experience of the pupil. Every principle studied is taken up in connection with a definite problem arising from some familiar occurrence. The interest of the high-school boy in steam engines, dynamos, cameras, automobiles, etc., is both stimulated and utilized. The spirit of the book is well typified by its numerous illustrations, which are mostly photographs of real objects, as distinguished from mere laboratory devices. Consistent adherence to the idea of a close union of subject-matter with the pupil's experience has borne fruit in the rejection of certain time-honored topics, as well as in the including

of some topics not generally treated in an elementary course. Especially good are the chapters on moments of force, motion of rotation, color, and optical instruments. It is to be regretted that the same consistency did not lead to giving the common units a place of importance co-ordinate with the metric system. One of the few unsatisfactory sections of the book is that dealing with engineering units. A striking feature of the book is the inconspicuous place occupied by mathematics. That this is due to skilful treatment and not to the omission of important relationships is best appreciated when one examines the numerous problems. No teacher can fail to be stimulated by a careful reading of this book. It does not appear to be very different, in point of difficulty, from other high-school texts. It should be more interesting. Above all, it is teachable. The publishers have done their part admirably, making the book as attractive in form as it is worthy in conception and execution.

A. A. KNOWLTON.

ARMOUR INSTITUTE OF TECHNOLOGY,
Chicago.

Great Pedagogical Essays: Plato to Spencer. By F. V. N. PAINTER, A.M., D.D. New York: American Book Co. Pp. 426.

It is a very real need that the editor of these selections has attempted to meet. The history of education is a large subject and the significent materials are available only in the original languages, or in translations, some of which are expensive and to be had only in complete editions of their author's works. With the growing interest in the study of education and its history, and the improved methods of instruction in these subjects, there has arisen a demand for first-hand acquaintance with the sources. To meet this demand within the compass of a volume of the size of the one under review is, of course, impossible; a selection of materials is all that could be expected. With selection comes the question of relative values, and no editor could hope to meet the views of his fellow-workers in the same field.

The twenty-six documents given in whole or in part in this handy volume are all of the first importance. They afford a basis for the formation of an opinion of the general character and trend of an author's work, and thus serve to give substance to the mere outline of the usual textbook.

As has been suggested before, it would be idle to quarrel with the editor's choice of documents, or to suggest important omissions. The student of education who is without access to a large library will be grateful for what the editor has provided, and will profit greatly by a careful study of these pages. Each selection is prefaced by a short biographical sketch of its author. A cursory examination has brought to light one typographical error: "*bedentendsten*" for "*bedeutendsten*," p. 159.

W. B. O.

Methods in Plant Histology. By CHARLES J. CHAMBERLAIN. Chicago: The University of Chicago Press, 1905. Pp. x+262, with 88 figs. $2.39.

Chamberlain has revised and rewritten much of his *Methods in Plant Histology*, adding several new chapters, elaborating and in many instances improving and shortening the processes. The new chapters deal with microchemical tests, free-hand

sectioning, special methods, the use of the microscope, and micrometric methods involving the use of the camera lucida.

The most notable new chapter is the one dealing with methods of staining filamentous algæ and fungi, and mounting them in Venetian turpentine. An abstract of the methods of Pfeiffer and Wellheim is given, together with such modifications as have been bound to give successful preparations. Such extremely delicate forms as Vaucheria can be carried through the stains and mounted in Venetian turpentine without showing the least trace of plasmolysis; and even if slight plasmolysis should occur, it can be corrected by manipulation of the mounting medium. The Venetian turpentine method, giving preparations requiring no sealing, and as hard and durable as balsam mounts, should almost entirely replace the troublesome glycerine method.

Much attention is given to collecting and keeping material alive in the laboratory. Klebs's method of securing reproductive phases in algæ and fungi is presented in a practical manner. Specific directions are given for making such preparations as are needed by teachers and others who wish a comprehensive view of the plant kingdom from the lowest to the highest forms.

The book will be very useful to teachers of secondary schools, as well as to independent workers, for it gives in usable and concise form the latest and most approved methods of modern micro-technique.

W. J. G. LAND.

UNIVERSITY OF CHICAGO.

German Higher Schools: The History, Organization and Methods of Secondary Education in Germany. By JAMES E. RUSSELL. Ph.D., LL.D. New York: Longmans, Green & Co.

This is a revised edition of the handbook on the German secondary schools by the dean of Teachers College, New York, first published in 1899, and reviewed in these columns. The new edition is enlarged by the addition of a chapter entitled, "The Progress of School Reform, 1898–1905," a "Bibliography of Recent Works on School Reform," and three appendices entitled "Royal Decree of November 26, 1900," "Curricula of Prussian Higher Schools of 1901," and "The Privileged Higher School of Germany in 1903–1904." These additions will render more useful what has already become a standard work on the subject. On p. 463 *ad fin.* "1903" should read "1900."

W. B. O.

Boys and Their Management in School. By H. BOMPAS SMITH, M.A., Headmaster of Queen Mary's School, Walsall; Formerly Assistant Master at Shrewsbury. New York: Longmans, Green & Co., 1905. Pp. 119.

While this small volume is written from the standpoint of the English school and for English schoolmasters, it contains a fund of practical wisdom born of experience that would be applicable under any conditions. The book is divided into two parts, the first of which, entitled "The Human Boy," deals with the physical and mental development of boys between the ages of eight and nineteen years and draws much of its material from Hall's *Adolescence*. In the second part, entitled "The Boy in School," the author speaks from his own experience, and reveals himself as a thoughtful and sympathetic student of the problems of his profession. We Amer-

icans should take exception to the author's views on corporal punishment, but, aside from this one point, the advice given teachers, both as to general attitude and as to specific problems, is admirable.

W. B. O.

Elementary Latin Writing. By Clara B. JORDAN. New York: The American Book Co., 1905. $1.

A textbook that is the product of actual experience in teaching always commands respect and often is, when announced, awaited eagerly as perhaps the solution of a vexing problem. Miss Clara B. Jordan's *Elementary Latin Writing* is a remarkably happy compromise between two widely divergent practices: that of teaching Latin grammar through composition, and that of teaching Latin composition and letting grammar take its chance. The latter practice, heralded as relief from intolerable drudgery, almost drove out of the field the so-called textbooks of Latin composition that were merely clever collections of e. g.'s. The result of this wholesome, but too wholesale, reform is well known and need not be mentioned. Now we are beginning to receive books conceived in a spirit of calm acceptance of two principles: that Latin grammar is satisfactorily taught only with the aid of Latin writing; but Latin writing is an end in itself, apart from its value in impressing upon the pupil's mind the facts of Latin grammar. Miss Jordan's book, which ought to be covered and reviewed easily in the high-school four-year course, proceeds gradually from intensive work on the grammar to connected passages of great variety and increasing difficulty. Throughout there is a certain crispness and directness that recommends this book as an extraordinarily useful manual. Individual features, the outcome of personal predilection of the author, add a charm unlooked for in the treatment of so unromantic a subject. Incidentally the exercises contain information that is of great value to the young student, especially the exercises numbered 7, 20, 21, 26, 27, 28, 29, 30, 32 and following. The coming of this and similar textbooks will perhaps rescue Latin composition from its anomalous position.

J. REMSEN BISHOP.

EASTERN HIGH SCHOOL,
Detroit, Mich.

Science of Education. By RICHARD GOUSE BOONE, A.M., Ph.D. New York: Charles Scribner's Sons, 1904. Pp. xiii+407.

Education is defined by Dr. Boone as "the life process by which the individual is matured," and the science of education as "the body of organized laws or principles in accordance with which this process takes place." Education in this broad sense thus becomes in the individual practically synonymous with development, its outcome in the race being civilization; and the science of education has for its rather extensive task "the explaining the nature of man as a developing creature, the motives and conditions involved in his maturing, and the social and personal factors that enter into the problem."

The underlying thought of the book, which becomes in the words of the author its "unifying principle," is that embodied in the previously quoted definition, viz., that education is fundamentally a process of human growth. All things that contribute to that growth are educative, and must be taken cognizance of in a science of

education. Education in its broad sense is thus distinguished from "schooling," which represents that phase of education which may be characterized as designed or directed. Having taken pains to make this distinction, the author's treatment would be clearer in places if he did not oscillate so readily from the one point of view to the other.

The book is divided into four parts, entitled respectively, "The Nature of Education," "Education as a Science," "The Data of Educational Science," and "Contributing Sciences." Of these the first and fourth receive the most lengthy treatments. The most carefully worked-out portion, and the one most in accord with a scientific treatment, is the part entitled "The Nature of Education," comprising the first 170 pages. In this part are stated and elaborated four presuppositions in reference to (*a*) the subject, (*b*) the instrument, (*c*) the motive, (*d*) the condition of education. The general line of treatment in working these out is in accord with current educational theory, as embodied, for example, in an elaborated form in Professor O'Shea's book *Education as Adjustment*. The educative process is seen to be summed up in the constant interaction of two factors: "the impulse to know and to grow" on the part of the individual, and the ever-present environment "which impinges upon the nerves and arouses the mind to action." Especially valuable is Dr. Boone's discussion of the motive in education, where he emphasizes the thought that real education is never secured by imposition from without, but rather by setting free and furthering the growth of the impulse from within.

The conclusion arrived at after a perusal of the whole book is that in it the author has not attempted, except in the most general way, to work out a science of education. This, according to his own broad definition and further expansion of it, would be a task practically equivalent to the writing of a history of all the factors responsible for man's development along every line of progress. He has confined himself rather to indicating some of the possibilities of a science of education, together with a statement concerning the spirit and method that should dominate scientific investigation and a suggestive survey of the body of material which a science of education has at its disposal. In the words of the author, a science of education "is at least in the making" —which, after all, is perhaps a more hopeful fact than if it were already "made."

The book under discussion is typographically pleasing and free from misprints. An error in historical fact is to be seen on p. 7, where Herbart is spoken of as Kant's successor at the University of Berlin instead of at Königsberg. A brief working bibliography of education and related sciences is appended.

H. C. HENDERSON.

STATE NORMAL SCHOOL,
Milwaukee, Wis.

Growth and Structure of the English Language. By OTTO JESPERSEN. Leipzig: B. G. Teubner, 1905. Pp. iv+260. M. 3.

Those acquainted with Jespersen's other books, as *Progress in Language*, will expect to find this new work suggestive and helpful. Jespersen is a keen observer and original in method. His work is always full of well-selected examples. The book before us shows all these qualities. It is especially suggestive by reason of the foreigner's view of our language. Little things, which English-speaking people might easily overlook, are more readily observed by one not to the manner born. Many of these are clearly pointed out by this keen Danish scholar.

As to general plan, there is perhaps a certain lack of proportion and harmony of parts. Exclusive of a "Preliminary Sketch" and the concluding chapter, the book consists of seven chapters on the vocabulary and one on the grammar. The last chapter on the vocabulary, called "Shakespeare and the Language of Poetry," occurs after that on grammar, rather than with those to which it naturally belongs.

The chapter on grammar scarcely gives a clear idea of development of inflections, partly because an attempt is made to cover syntax at the same time. While the two are closely related, they can hardly be treated to the best advantage together. Even the treatment of inflectional leveling shows a curious grouping. Discussion of the *s* (*es*)-genitive and plural of nouns suggests the *s*-ending of the third singular in verbs. So the archaic and poetic *th*-ending of verbs is followed by the *th*-ending of ordinal numerals. While there is no hint of connection between the two, the arrangement emphasizes casual rather than essential relations.

In this part also we notice some less accurate statements. It is perhaps unwise to say that consonant change in verbs "has been abolished (?) altogether except in the single case of *was-were*" (p. 179), when modern readers are sure to meet *seethe-sod-sodden* in Shakespeare and the Bible. For later English, of course, *seethe* has largely given away to the borrowed verb *boil*. More to be criticised is the sentence: "In modern English we restrict *brothers* .... to those of the family, using *brethren* .... of different families" (p. 190). *Brethren* is archaic, liturgical, and poetic. "Most of the words that make their plural like the singular are old neuters" (p. 190) is not wholly true. It is true for most native words. It is not true that "a solitary precursor [of the *s*-third singular of verbs] is found in Chaucer" (p. 192). Ten Brink, indeed, gives but the one instance Jespersen cites (*Duchess*, 73), but it is found also in *Duchess*, 257; *Fame*, 426,1907, at least. The pronoun *which* is not restricted to things (p. 204), but is no longer used for persons. *Who* and *which* were not "originally interrogative pronouns only" (p. 206), but indefinites as well, and it is probably through this indefinite use that they became relatives. One might select some other minor points in which the foreigner betrays his lack of acqaintance with certain forms of English usage.

The best part of the book is in the chapters on vocabulary. These emphasize the foreign-derived material, but the treatment is always interesting. Perhaps one might mention especially those on Scandinavian and French elements. Even in treating vocabulary, however, one evidence of faulty method must be noted. Of Shakespeare Jespersen says (p. 215): "His reticence about religious matters .... is shown strikingly in the fact that such words as *Bible*, *Holy Ghost*, and *Trinity* do not occur in all his writings." A glance at the Concordance of Milton's poetry shows that only the second one occurs in all of Milton, and that only once. The conclusion is obvious.

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BOOKS RECEIVED

(The notice here given does not preclude the publishing of a comprehensive review.)

EDUCATION

Course of Study in the Eight Grades. 2 vols. By CHARLES A. MCMURRY. New York: The Macmillan Co., 1906. Vol. I, vii+236; Vol. II, pp.v+226.

The Physical Nature of the Child and How to Study It. By STUART H. ROSE. New York: The Macmillan Co., 1906. Pp. xii+211. $0.90.

A reprint, with a few additions to the bibliography, of this practical and sensible guide to the study of children.

HISTORY AND CIVICS

School History of the United States. By HENRY WILLIAM ELSON. New York: The Macmillan Co., 1906. Pp. xvii+467.

City Government for Young People. A Study of the American City Adapted for School Use and for Home Reading for Children. By CHARLES DWIGHT WILLARD. New York: The Macmillan Co., 1906. Pp. xiv+170.

ENGLISH

Select Poems of Robert Browning. Edited, with Notes and an Introduction. By PERCIVAL CHUBB. New York: Longmans, Green & Co., 1905. Pp. xxii+96. $0.40.

Washington Irving's Sketch Book. With an Introduction by BRANDER MATTHEWS and with Notes by ARMOUR CALDWELL. New York: Longmans, Green & Co., 1905. Pp. xxiii+428. $0.40.

Elizabeth Gaskell's Cranford. Edited, with Notes and an Introduction, by FRANKLIN T. BAKER. New York: Longmans, Green & Co., 1905. Pp. xxiv + 239. $0.40.

Benjamin Franklin's Autobiography. Edited, with Notes and an Introduction, by WILLIAM B. CAIRNS. New York: Longmans, Green & Co., 1905. Pp. xx + 203. $0.40.

Shakespeare's Twelfth Night or What You Will. Edited, with Notes and an Introduction, by JOHN B. HENNEMAN. New York: Longmans, Green & Co., 1905. Pp. xxxviii+135. $0.40.

Selections from Spenser's Faerie Queen. Edited, with Notes and an Introduction, by JOHN ERSKINE. New York: Longmans, Green & Co., 1905. Pp. xxiv+179. $0.40.

Shakespeare's King Henry the Fourth. Edited, with Notes and an Introduction, by GEORGE C. D. ODELL. New York: Longmans, Green & Co., 1905. Pp. lxvi+146. $0.40.

Palgrave's The Golden Treasury. Edited, with Notes and an Introduction. By HERBERT BATES. New York: Longmans, Green & Co., 1905. Pp. xv+vii+459. $0.40.

These eight volumes, recently added to Longmans' well-known series of English classics, issued under the general editorial supervision of Professor George Rice

Carpenter, maintain the now almost traditional standard of this series for thorough and many-sided editing by competent scholars.

Scott's The Lay of the Last Minstrel. With a short Biography by ANDREW LANG, and an Introduction and Notes by FRED. W. TICKNER. New York: Longmans, Green & Co., 1906. Pp. xxii+121. $0.36.

The First Chapter of Macaulay's History of England. Edited by DAVID SALMON, New York: Longmans, Green & Co., 1905. Pp. viii+184. $0.50.

Scott's A Legend of Montrose (abridged). With a Short Biography by ANDREW LANG, and Introduction and Notes by R. LISHMAN. New York: Longmans, Green & Co., 1905. Pp. xvii+222. $0.50.

Scott's Ivanhoe (abridged). With a Short Biography by ANDREW LANG, and Introduction and Notes. New York: Longmans, Green & Co., 1905. Pp. xxv+191. $0.50.

Scott's The Talisman (abridged). With a Short Biography by ANDREW LANG and Introduction and Notes by J. THORNTON. New York: Longmans, Green & Co., 1905. Pp. xxvii+204. $0.50.

Shakespeare's Twelfth Night. The Swan Edition. With Notes by Alfred L. CANN, and ten full-page illustrations by GREENVILLE MANTON. New York: Longmans, Green & Co., 1905. Pp. xxiii+111. $0.35.

Shakespeare's Much Ado about Nothing. The Swan Edition. With Notes by ROBERT WILLIAMSON, and ten full-page illustrations by H. R. Millar. New York: Longmans, Green & Co., 1905. Pp. xxx+126. $0.35.

Webster's First Bunker Hill Oration and Washington's Farewell Address. With Preface, Notes, and Introduction by A. J. GEORGE. New York: Longmans, Green & Co., 1905. Pp. xxii+61.

Word Studies, Advanced Book. By EDWIN S. SHEPPE. Richmond: B. F. Johnson Publishing Co., 1905. Pp. 126.

English Grammar for Beginners. By JAMES P. KINARD. New York: The Macmillan Co., 1905. Pp. ix+253. $.50.

The Elements of English Grammar. With Suggestions for Composition Work. By ALBERT LEROY BARTLETT AND HOWARD LEE MCBAIN. New York: Silver, Burdett & Co., 1905. Pp. viii+345.

MATHEMATICS

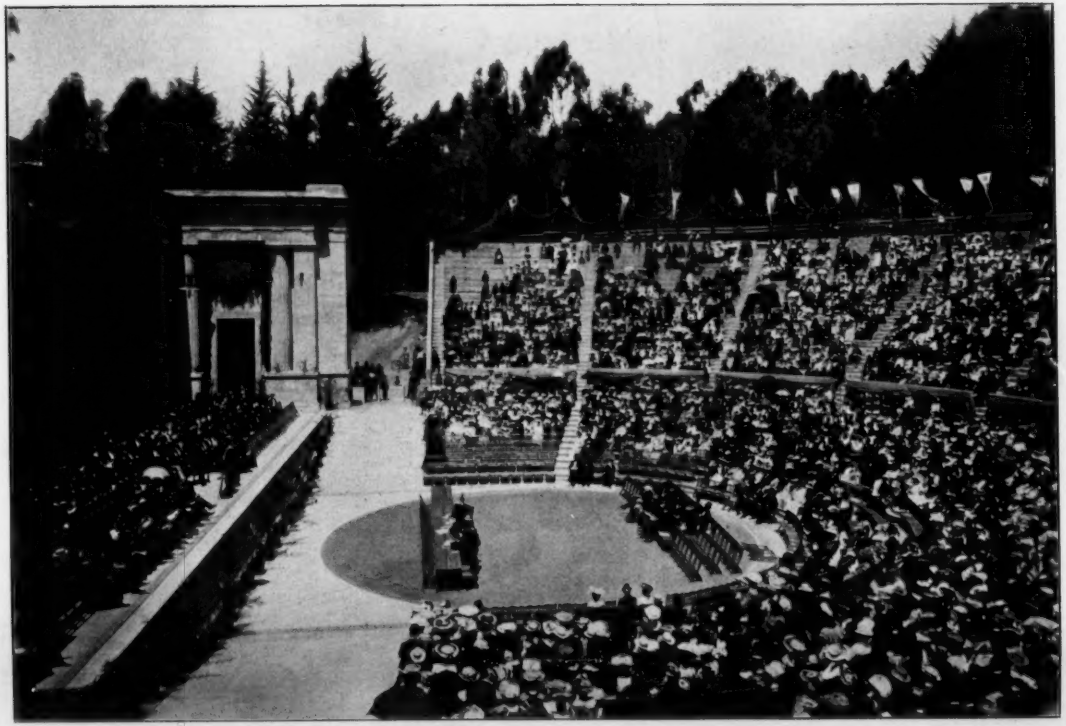
Practical Mathematics. Third Edition. (Stage I.) New York: Longmans, Green & Co. 1904. Pp. viii+378.

Advanced Algebra. By ARTHUR SCHULTZE. New York: The Macmillan Co., 1906. Pp. xiv+562. $1.25.

A Course in Practical Mathematics. By F. M. SAXELBY. New York: Longmans, Green & Co., 1905. Pp. viii+438.

SCIENCE

Giant Sun, and His Family. By MARY PROCTOR. New York: Silver, Burdett & Co., 1906. Pp. iii+167.



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